DECEMBER
1946

IN THIS ISSUE:
Effect of Variable Flow on Sedimentation
Water Softening
Ditch Retards to Prevent Erosion

Public Works Magazine

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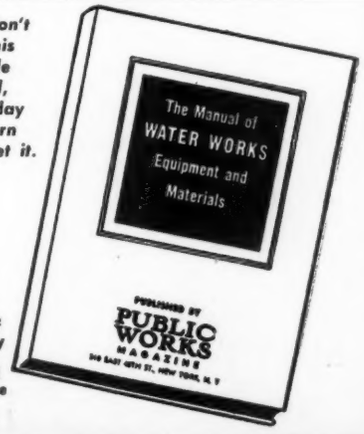

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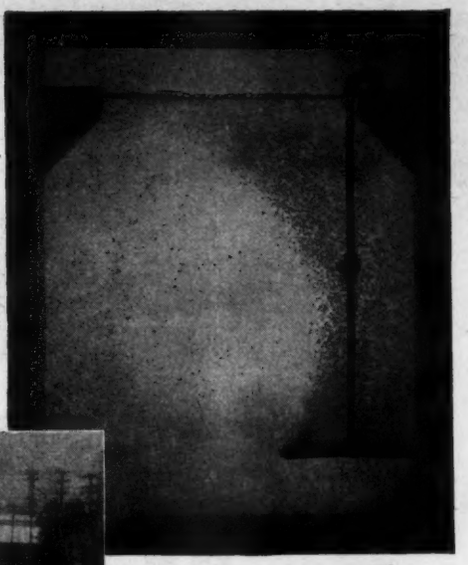
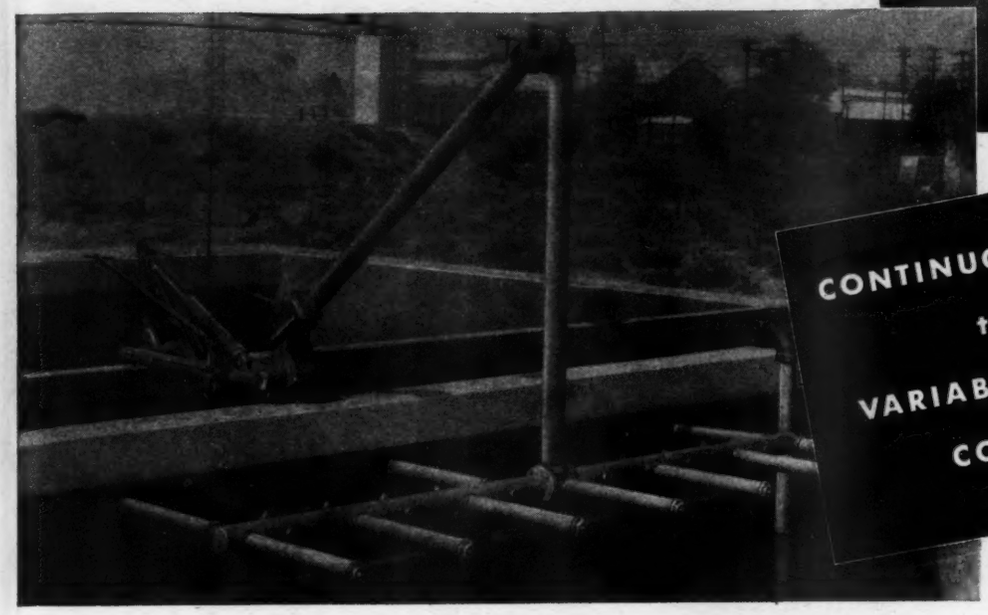


Scale model Swing Diffuser in operation showing the Chicago Wide Band Air Diffusion System.



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Founded in 1896

Devoted to the interests of the engineers and technical officials of cities, counties and states

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W. A. HARDENBERGH and A. PRESCOTT FOLWELL
Editors

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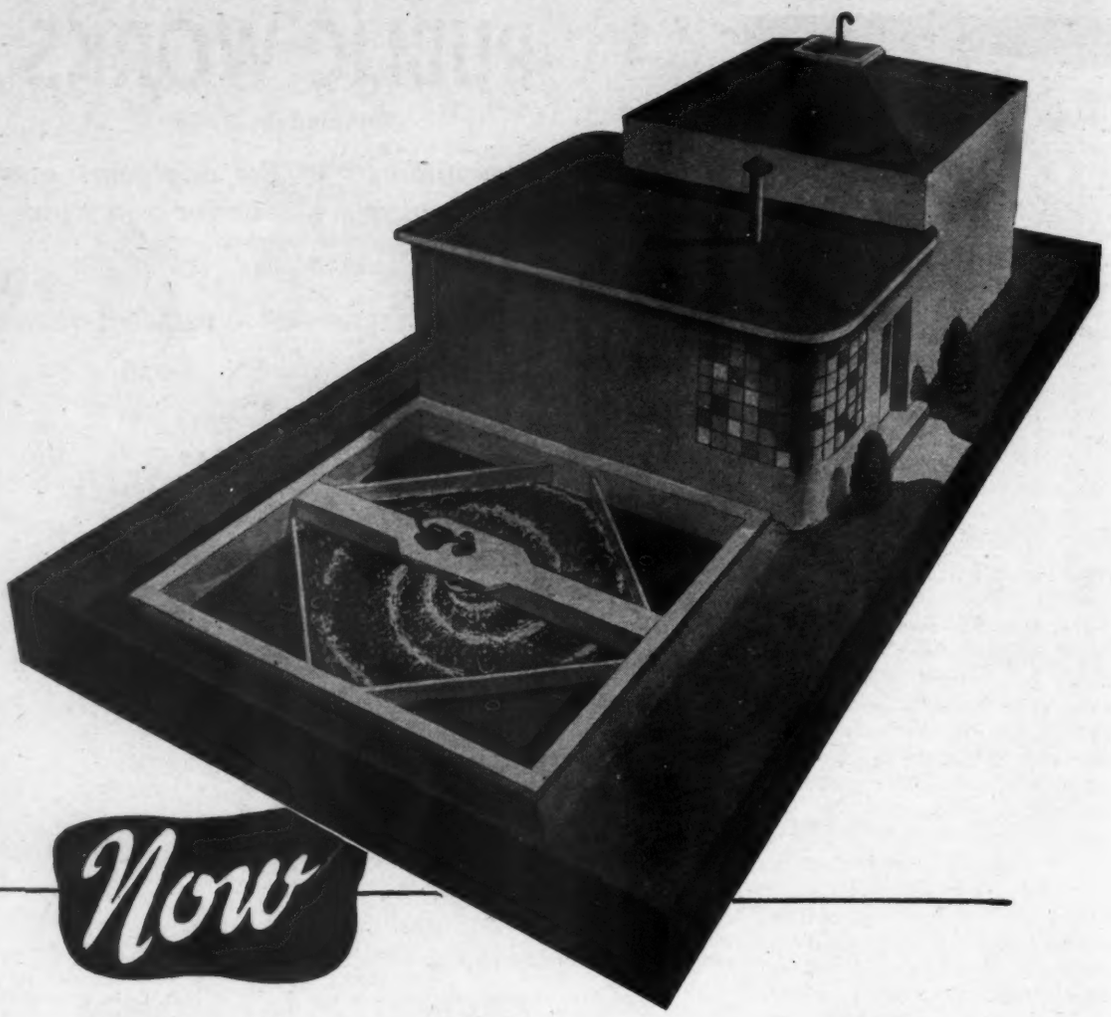

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The Editor's Page

Engineers Should Retain Their Military Reserve Commissions

We hope that all of the engineers who held commissions in the construction or engineering groups of the Army and the Navy will retain their commissions in the post-war reserve; and that they will take an active part in military affairs. This participation should be based on full equality and on an appreciation of the contributions that the civilian engineer can make; it is a job for men, not mice.

During peacetimes, the engineers of the army and the navy, under pressure of every-day routine, drift away from civilian engineering work, lose touch with many civilian specialties, and tend to become narrow specialists in the military field. When an emergency comes, and the problems of largescale construction of roads, airports, buildings, docks, water plants and sewerage systems arise, the civilian specialists must be called in.

Obviously the civilian is more effective and valuable if he knows something of the ways of military thought and the intricacies of military procedures. He can learn these only by participation in reserve affairs and in army training. With this understanding of military procedures, he can more quickly and effectively contribute his knowledge of his specialty and can apply it immeasurably better to military conditions. A close and friendly contact in peacetime between the regular and the civilian reserve officer will permit them to work more closely, and will help to eliminate the greatest difficulty of all—the lack of appreciation, based on lack of knowledge on the part of the regular army officer, of the needs and the possibilities of usefulness to the military of the civilian specialties.

Realism in Refuse Collection and Disposal

If there is any place where realism and commonsense should prevail, it is in refuse collection and disposal, but there is still a good deal of shutting eyes to facts and seeking silver linings that aren't there. Bluntly stated, refuse collection and disposal are responsibilities of the municipality and to discharge these responsibilities properly costs a good deal of money. Careless and inadequate methods of collection and disposal prevail altogether too widely, and are largely responsible for prevalence of flies and rats, which in turn may be responsible for a great deal of disease.

Letting the farmer or the scavenger collect refuse, in open and leaking vehicles, is the lazy way, and is merely an evasion by city officials of their responsibility. There is no substitute for good municipal collection, employing covered, tight, low-loading and specially designed vehicles and equipment. The citizens pay, but they get less for their money with private collectors, even though there are contract terms or franchises involved.

Disposal by proper methods costs money, too. But if the job is only half done the community pays even more in nuisance, disease and discomfort. Incineration has done a good job; it costs money, but there are sufficient data available so that any community can pretty well determine what its costs will be. That is not true with some of our other methods, and specifically with sanitary fill. That method of disposal is an excellent one also, where local conditions are suitable, but the costs incident to its use have not been fully evaluated for the various sizes of communities and for various conditions. Nor have fixed procedures for it generally been developed or adopted—procedures that are necessary in order for the process to live up to its name. This should be done and the process of disposal standardized for use by those municipalities for which it is suited.

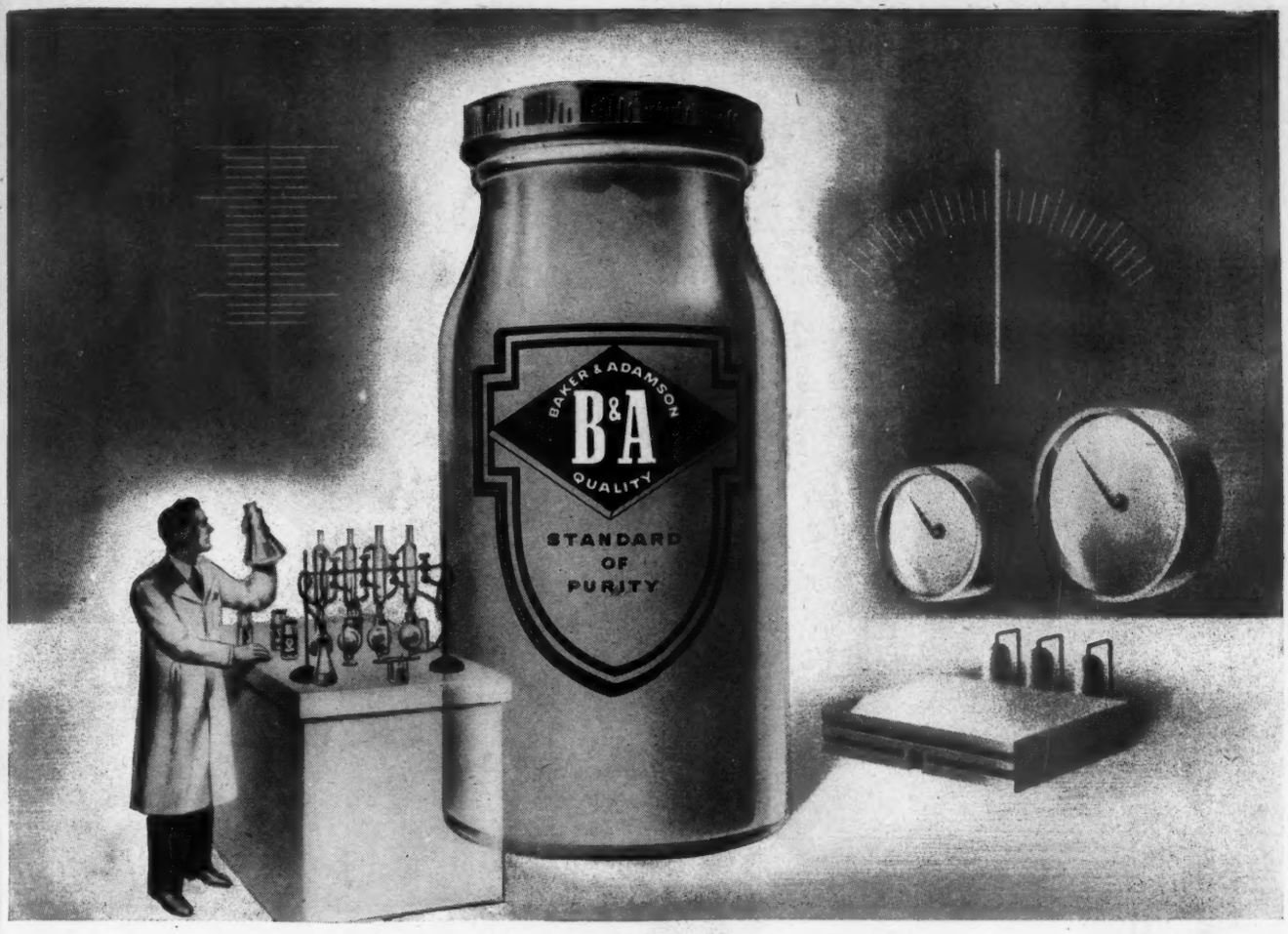
A History of Army Sanitary Engineering

A good many inquiries have been received as to whether or not there will be prepared and published a history of sanitary engineering activities of the war. Before the writer of this item left the Army he prepared a fairly comprehensive report of the multitudinous activities of the Sanitary Engineering Division. This has since been referenced and, to some extent, edited. The original contained somewhat in excess of a thousand paragraphs, and will probably require one large volume or two medium volumes for publication. So far as is known, it is the intention of the War Department to publish these with moderate promptness.

Due to the very great scope of the work done, it was impossible to give many details in this report, and it naturally represents the overhead and organizational viewpoints. It was necessary to summarize and condense very materially the voluminous reports received from overseas theaters, and to dismiss Service Command problems with little more than a single paragraph for each. However, it is believed that this report will be of interest and value, both to sanitary engineers and as a guide for the future in case another emergency should arise. If and when information becomes available regarding publication, our readers will be informed promptly.

Building Safety Into Highways

Safety can be built into highways; it costs a lot of money to do it and it is worth all it costs. Some fifteen years ago, a nationwide program was inaugurated to eliminate grade crossings. Largely or wholly as a result, the grade-crossing accident rate based on train and automobile miles traveled has declined 65%, and even with the increase in travel, there are 14% fewer grade-crossing accidents than there were in 1923. Statistics show that about 55% of automobile accidents occur at road intersections. A program for the elimination of the more dangerous intersections, just as the more dangerous grade crossings were eliminated, would very materially cut our automobile accident rate. Wider highways, better sight distances, divided traffic lanes, limitation of access to highways, safer curves, stabilized shoulders and wider and shallower ditches can do a great deal toward reducing accidents. All of them require money. In general, if gas tax revenues were used wholly for road construction and improvement, and not diverted to other purposes, there would be enough money to go a long way toward this necessary modernization of our road system, with a consequent marked reduction in highway accidents.



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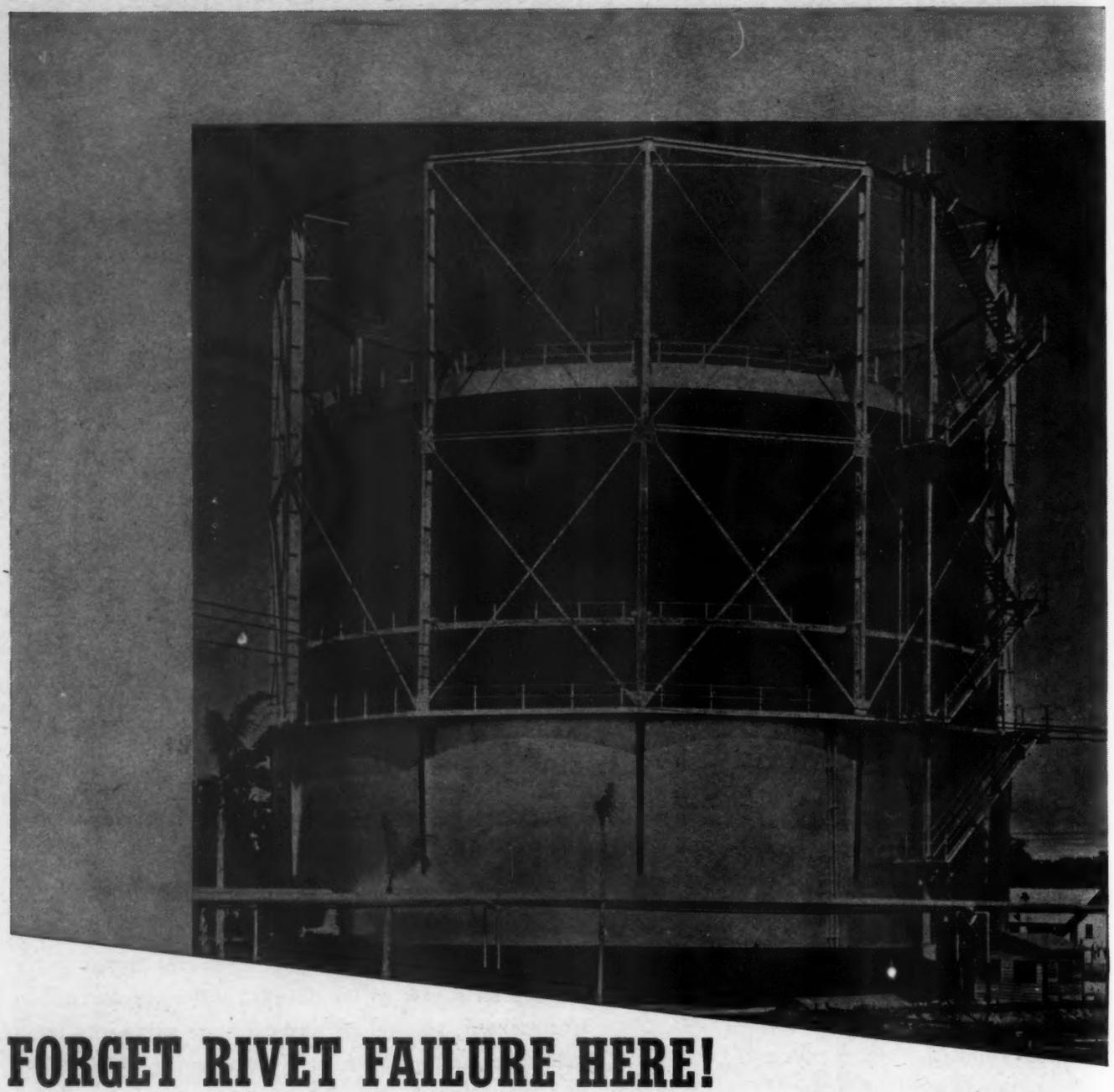

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Our experience includes more than three hundred distinct types of tanks—any practical size or shape—with gas holders ranging in capacities from 100 cu. ft. up to 10,000,000. We fabricate as light as No. 16 gauge sheet metal, and up to three inches thick.

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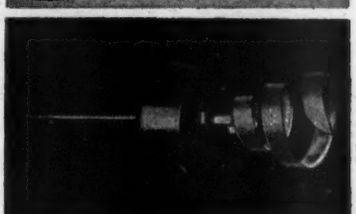

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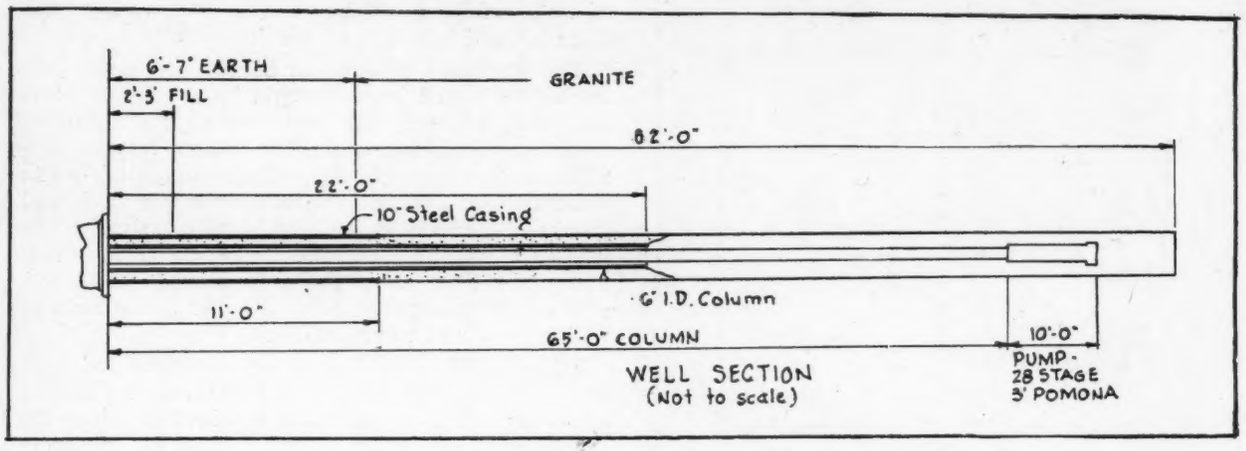


Drawing showing well section and details.

Factors in Selecting and Puchasing Deep Well Pumps

Selecting the pump; details of specifications; a check list for items to be considered; advice on procedure; bonus and penalty arrangements.

By FRANK E. HARLEY

Harley & Garlick, Consulting Engineers

AFTER a well has been completed and data are available regarding the quality of the water, the quantity available and needed, and the best working depth, specifications can be drawn for the pump. It is generally desirable to require that the pump be installed by the supplier as this insures proper installation and responsibility for its operation. A pump should have a good background, and it must be backed by a reliable manufacturer with experience and "know how" in pump building. And it is just as important to have the pump installed by an experienced contractor, with trained mechanics and proper tools and equipment.

The pump specifications currently being prepared for the American Water Works Association by Chairmen J. Arthur Carr and James C. Harding, while still in a preliminary form, will be found very helpful. Specifications should give all available data on what is desired from the pump, as this will enable the manufacturer to offer the pump best suited for the particular service. Economy in pumping is the desired end; therefore, complete data on the well, including volume, working level, diameter, depth and formation, and plumbness should be furnished; also the discharge conditions—whether it is to pump into the distribution system, a ground reservoir or settling basins; and the power requirements, current and standby drive.

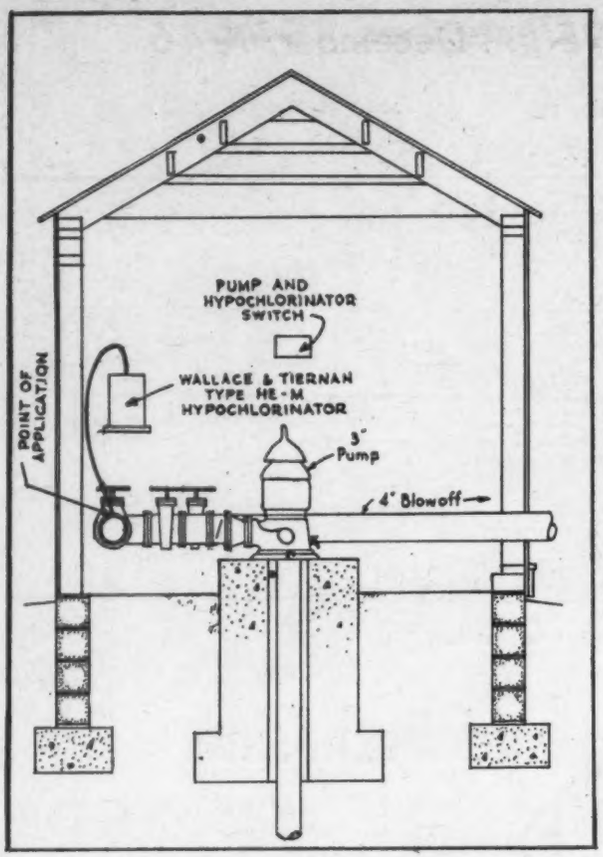
The wire to water efficiency should be required, with the bidder stating his expected efficiency and provision being made for either a penalty or a bonus, depending on whether the efficiency is or is not met. The specifications should clearly state the manner of test, the method and equipment to be used, and what variations will be allowed.

After the bids have been received they may be evaluated to either the highest or lowest efficiency in order to ascertain the least costly pump. In this way, a low bid on a low efficiency pump may be shown to be more costly than a somewhat higher bid on a higher efficiency pump. Similarly, a lower bid based on using a smaller shaft and column, and overloading a motor, may be evaluated. An example of bid evaluation, with a penalty or bonus of $75 for each 1% above or below standard, is:

Pump Bid	*Amount of Bid*	*Efficiency*	*Evaluated Bids on Basis of 72%*
"A"	$3,000	62%	$3,000 plus $750, or $3,750
"B"	3,500	70%	3,500 plus $150, or 3,650
"C"	4,000	72%	4,000 @ 72% or 4,000

On this basis, Pump "B" would be the least costly. Likewise, if one of these pumps had a smaller motor, say 5 hp. smaller, a deduction should be made to equalize all of the pumps on the same horsepower; and allowances can be made for size, weight and materials of the pump column, size and material of the drive shaft, type of bearings, and other items, unless these are distinctly required by the specifications.

The bid should cover the cost of complete installa-



Section of a simple pump house.

tion, with all electrical work, auxiliary equipment, etc., ready to run, including a trial operation of at least eight hours by the contractor's mechanics. The specifications should provide for a guarantee for one year against defective material or workmanship, with replacement at no cost. This year of maintenance, when backed by a well-qualified service organization means a great deal, and perhaps there should be a monetary allowance for service when evaluating the bids. Generally, a competent operator will be in charge of the pump station, but he is seldom able to do extensive mechanical repair work, and therefore quick and efficient service is worth a great deal, particularly during the first year of operation.

After the installation is completed and the pump has operated satisfactorily for a week, initial payment should be made for a specified percentage of the bid, and the balance paid immediately after the efficiency test has been conducted and the penalty or bonus decided, completing the evaluation outlined above.

It is desirable to have the pump contractor furnish and install, in addition to the pump, all necessary operating equipment, such as automatic controls, the electrical work, meter board, check and gate valves and piping to a designated point of discharge. Such specialized equipment as a chlorinator and a venturi or other meter can generally be purchased on a separate contract with the manufacturer of such equipment.

The nature of the water, whether alkaline, acid or corrosive, may determine the materials to be used in the pump. Usually the manufacturer is glad to suggest suitable materials to use.

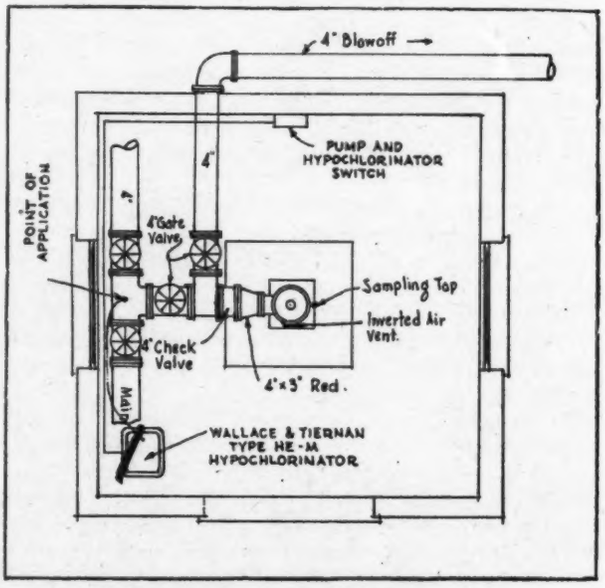
The drive shaft can be of cold drawn or stainless steel. The threads should be cut accurately, preferably on a lathe, and the ends of the shaft should be so cut that they can be drawn up tight against each other in the coupling. It is advisable to have a small hole drilled in the center of the coupling where the ends of the shaft meet to permit the escape of any air or water. If oil lubrication is used, it is necessary to have an enclosing pipe. Either oil or water lubricated bearings may be specified, or an alternate provided. The spacing of the bearings should be sufficiently close to prevent vibration and maintain proper alignment.

The discharge column can be of steel, plain, galvanized or coated, or of wrought iron or copper bearing steel. The material used may depend upon the character of the water, and the column may be furnished with either screwed or flanged couplings. The latter require a lot more room for the bolt circle and generally the screwed coupling is more desirable. The lengths of shafting, enclosing pipe and column generally should not exceed 10 ft., for ease of installation, and this length can be handled better in the average well house than longer sections.

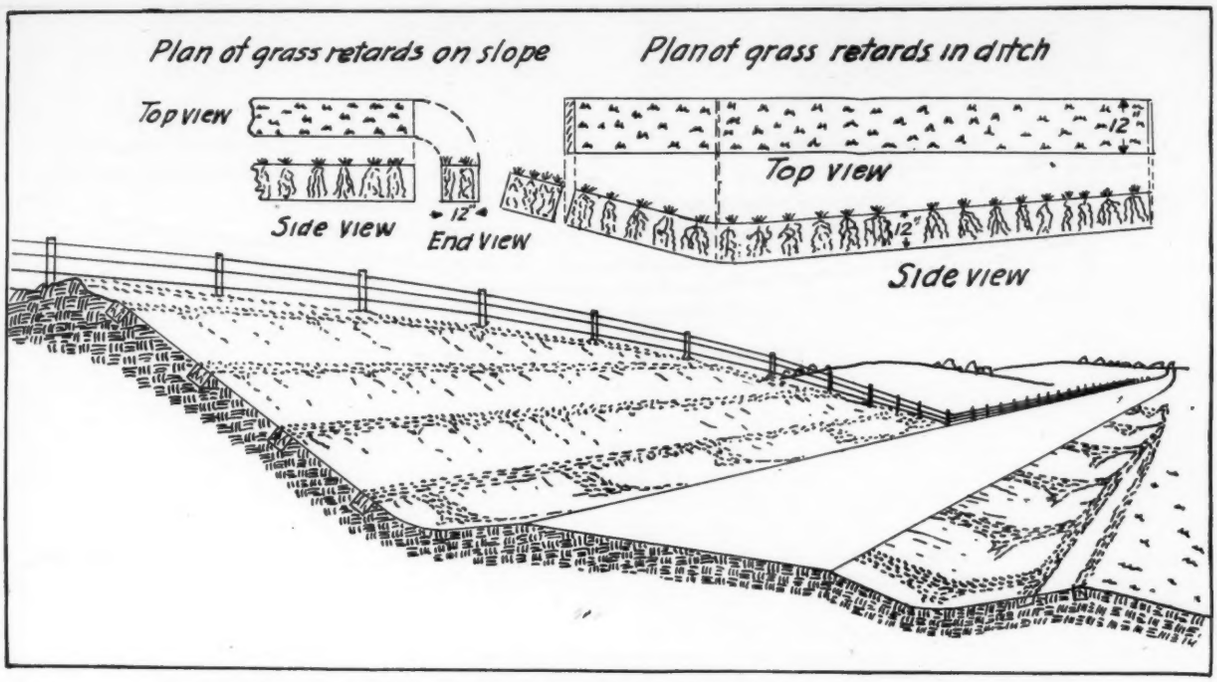
The question of open or closed impellers and bowl materials, whether bronze or other metal, plain or enameled finish, may either be specified or left to the judgment of the pump bidder. The size of motor to be used can also be stated in the specifications or left to the bidder; in any event, the motor should be large enough to operate under maximum conditions without undue strain or heating. The specifications should also state whether the installation is to be indoors or outdoors, and whether the location will be damp or fairly dry. The maximum speed of the motor should be specified; generally speeds over 1,800 rpm. are undesirable. The pump should be equipped with a device to prevent reverse rotation.

The discharge of the pump, whether above or below floor, should be specified. It is generally desirable to have above-floor discharge, and some State Boards of Health require this. Their regulations should be checked. The pump should be properly aligned with the well and, after shimming up to the best operating conditions, the pump should be grouted to the foundation. Many pump operators prefer a free floating mounting and grouting the base down does not interfere with this. If a pump is properly grouted to the base after aligning, it should not require any bolting. The concrete foundation should be sufficiently heavy

(Continued on page 34)



Floor plan of the pump house above.



Ditch and back slope retards. Usual ditch slope is 12:1 and bank slope 4:1. Retards are 12" deep and 12" wide.

Ditch Retards to Prevent Erosion

Texas experiences and practices in the construction of various types of retards, especially those utilizing vegetation.

By G. B. FINLEY
Maintenance Engineer, Texas Highway Department

IN OUR opinion, ditch retards or baffle dams to prevent ditch erosion can be constructed from vegetation at much less cost, and be more effective, than from rock, except in those localities where there is plenty of rock along the right-of-way. In such cases, rock dams may be ornamental and also can utilize otherwise unsightly rock. Our procedures and experiences with retards are detailed below.

Bermuda Sod Retards

Bermuda Sod Ditch Retards.—Most of the ditch retards of this type are constructed of bermuda sod cut in blocks and planted in trenches across the ditches. This type of ditch retard gives best service on rather flat slopes and in ditches that do not carry a heavy volume of water. The spacing of the retards should be varied in accordance with the gradient of the ditch and the volume of water. [See sketch herewith.]

Bermuda Sod in Sacks.—This type of retard is used in shallow ditches on light grades and is especially adapted to ditches with steep gradients. Old burlap bags are filled about ¾ full of moist bermuda grass sod and placed like sand bags in the ditches. For shallow ditches the bags are laid in one layer end to end across the ditch, with bags at each end well above high water level. In deep ditches with steep grades three or more layers of bags may be placed across the bottom of the ditch to obtain the height desired. Each layer of bags should be well tamped so as to prevent water from passing between them. One row of bags should be placed up each slope to a point well above the estimated high water level. As these sacks rot away the bermuda will take root and leave a solid grass dam. In some cases, due to the extreme velocity of water over these retards, we have found it necessary to combine the bermuda grass with rock to prevent scour on the lower side.

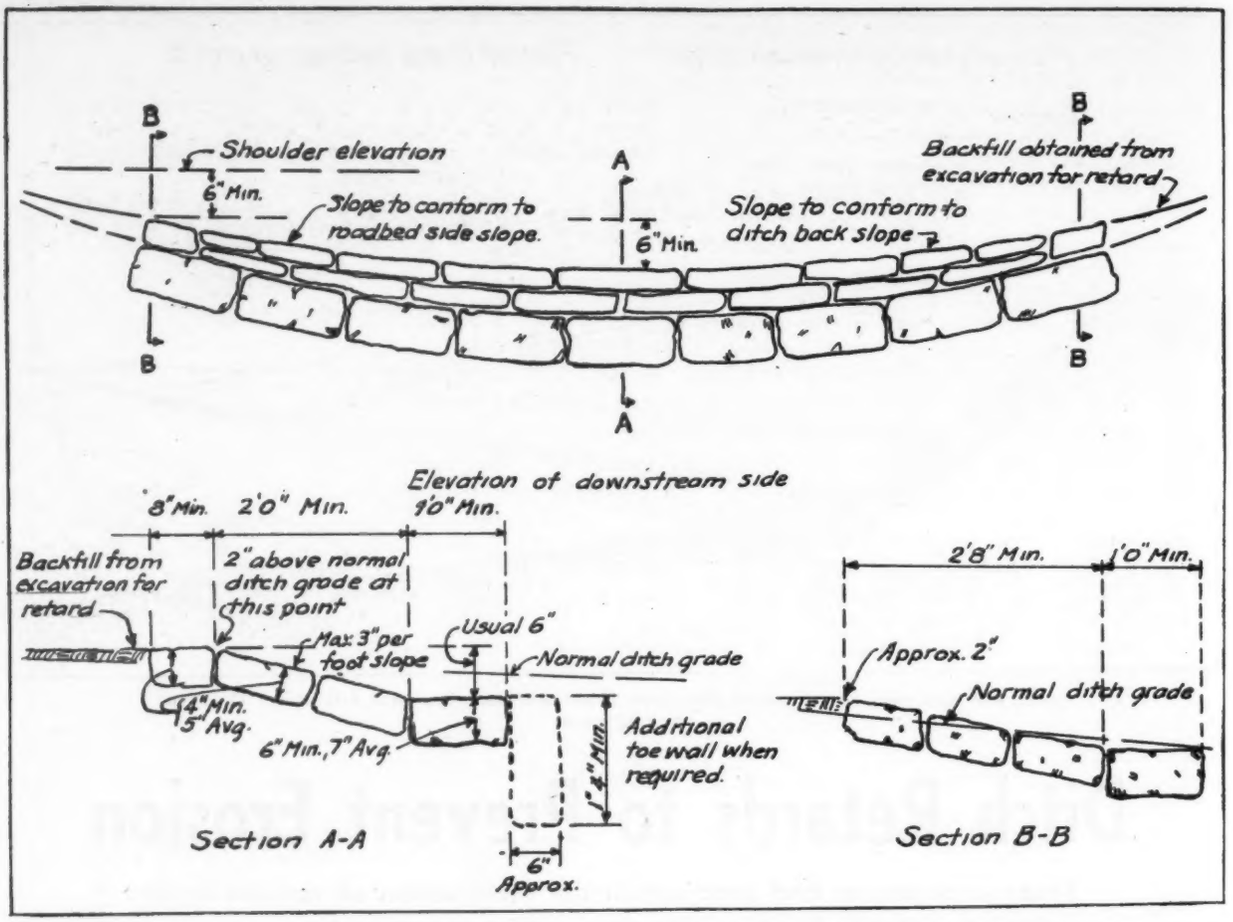
Rock and Wire Mesh Retards

Rock Retards.—Rock retards should be constructed of selected stone not less than 8" x 12" x 6". Care should be taken to break all joints. No mortar is to be used unless the retards wash out, in which case they may be replaced using mortar. The cross section of the retards should conform to the original cross section of ditches. All excavation should be well tamped against the retard. The amount of water carried by the ditch will govern the width, with outer edges of the retard extending past limits of high water level. [See the sketch herewith.]

Wire Mesh and Rock Retard.—This type of retard is used in deep ditches that have washed as much as two feet or more below the original grade. Extreme care should be taken in placing either a wire mesh retard or a rock retard. Both should extend back into the side banks so that the water will not cut around the retard and thereby make the ditch wider.

Other Types of Retards

Mulch Sodding.—This type of sodding is used when a large area is to be covered. The first operation,



Typical rock retards, spaced as required by soil and drainage. About 0.9 cu. yd. of rock required with 0.4 yd. additional for toe wall.

if the grass to be used is long or weedy, is to mow it. Long grass and weeds prevent easy spreading. The sod is then thoroughly disced to chop up the roots and rolled into a windrow with a blade. This pulverized sod is then loaded by hand, or by shovel or dragline.

On the area to be sodded, fertilizer may be broadcast at the amount desired and the section is then thoroughly cultivated to assure a good knitting of the sod with the soil. This can be done with a spring toothed harrow or with scarifier attachment on blade.

The sod is then dumped on the prepared sections and spread with a blade and then ironed down with a fresno. On flat slopes and ditches it can be rolled with truck wheels. The sod is then thoroughly soaked with water.

In sections where bermuda grass is very scarce, the sections could be covered with a good top soil and then sprigged with grass roots.

Stabilizing Shoulders

Following is a brief description of two methods generally used by us in stabilizing shoulders.

Stabilizing Shoulders With Cut-Back Asphalt.— This consists of surfacing shoulders or a portion of the shoulders next to the edge of concrete pavement with a compacted mixture of selected local and asphaltic materials.

The selected materials should consist of granular material as found, at the surface, and when loaded should not contain an excess of clay. The select material should be stripped of grass and other vegetation with tractor and blade. The material is then bladed into windrows. Material over 2½ inches in its largest dimension should be broken up and uniformly mixed with the remainder of the material before loading.

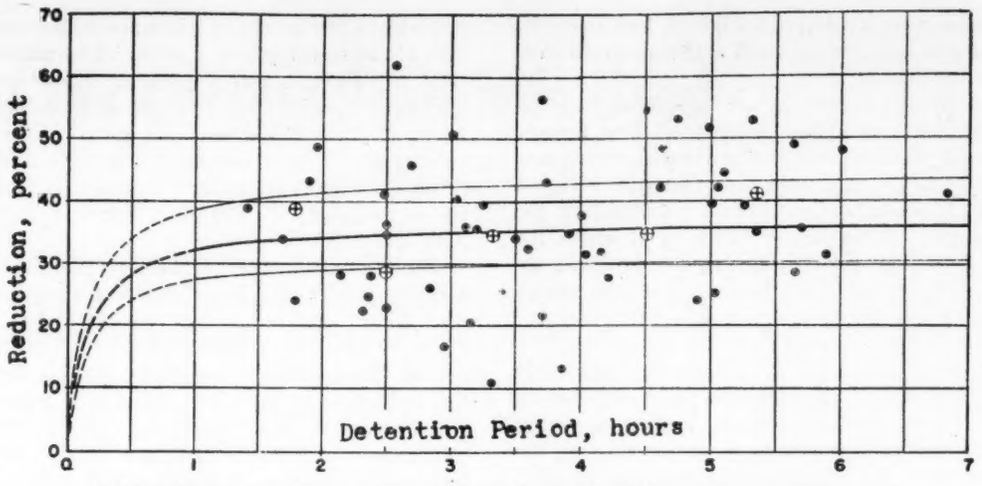
The materials may be batched either by weight or by volume; and mixed either at the material pit or at the site of the work. The mixer may be of any approved type that will give a uniform and complete circulation of the materials in the mixer and will produce a thorough and uniform mixing of the select material with the cut-back asphalt.

The trench for the stabilized select material is cut to grade, wide enough to accommodate side forms. If forms are not used, a considerable amount of material must be allowed for feather-edging. The asphaltic mixture should be spread in a layer or layers of such depth that after receiving compaction by rolling, the requirements of the typical cross section will have been fulfilled. The asphaltic mixture should be compressed thoroughly and uniformly with a truck of at least 1½ tons capacity equipped with dual pneumatic tires on the rear wheels, the truck being loaded not in excess of rated capacity. The truck should be driven at a speed of approximately 15 miles per hour and the full width of the surface to be compacted covered by the truck wheels in successive trips. Rolling in this manner should continue until the material is compacted thoroughly. The forms (if used) are then removed and carried ahead after the rolling has been completed.

The compacted material is allowed to set for one to two days after which its surface is smoothed by blading. To allow for this operation, it is necessary to leave the surface slightly high at the time of rolling.

We have received good results by mixing 20 gallons

(Continued on page 35)



BOD Reduction in primary settling tanks without recirculation—BOD over 350 ppm.

Effect of Variable Flow on Sedimentation of Sewage

Analyses of effects of variable flow, as indicated by study of military sewage treatment, and its influence on municipal treatment.

TO THOSE interested in municipal sewage treatment plants, one of the most important considerations connected with the report on "Sewage Treatment at Military Installations" (see *Sewerage Digest* for November) is the applicability of the various findings for these army camps to similar plants in municipal service. It should be recognized, of course, that there are differences between conditions at these two classes of plants; difference between the sewages treated, between plant designs, and plant operation; and that it would be incorrect to assume that conclusions drawn from these military installations would apply without modification to municipal ones.

But this does not mean that nothing is to be learned from such comparisons. On the contrary, the existence and study of the effect of extreme conditions found at military installations may reveal much of value which it is difficult to detect where these conditions are relatively minor to other coincident ones. One of the most important of these extreme conditions was the variation in both volume and strength of flow, both hourly and that due to frequent considerable changes in population. For example, at posts of 31,600 to 41,000 population, the minimum 4-hr. average flow was 43% of the average and the maximum 4-hr. average was 140%; and, comparing the pounds of BOD per hour, the minimum 4-hr. average was 11% of the average, the maximum 4-hr. was 162%, and the maximum 1-hr. was 201%. At some small posts the variations were much greater. At Will Rogers Field, 4,220 population, the minimum 4-hr. flow was but 7% of the average and the maximum 1-hr. was 279%; and the minimum 4-hr. BOD was 3% of the average while the maximum was 283%. Taking the average of a number of posts, one-quarter of the BOD load (in pounds) arrived in only 3 to 4 hr., and three-quarters in 11 to 13 hr. The suspended solids loading exhibited a significantly greater concentration than that of BOD in most of the smaller plants. Even these figures do not tell the full story. "The increase in flow during the early morning hours was so rapid that a series of traveling waves was created in the sewer system."

This non-uniformity of flow at military installations resulted from the regimented mode of life at cantonments inherent in military training, and to improper pump sizes and float switch adjustments at many posts. It is believed that this non-uniformity, more than any other factor, was responsible for the differences in settling efficiency observed between military and civilian plants. Measured by removal of BOD, performance at the former was distinctly inferior, in spite of the fact that detention periods in these were longer than those usual in municipal practice. The hypothesis was suggested that the poor performance was due to too great length of detention periods, but the data indicate a definite, though small, increase in BOD reduction with detention periods longer than 2 hr.

The report contains an analysis of the influence of flow variation upon sedimentation efficiency which would seem to be of considerable value in connection with municipal plants also. This analysis, somewhat condensed, is as follows.

Consider the region in a rectilinear tank in the vicinity of the effluent weir, which is located at the end of the tank. With a fixed rate of flow per unit length of weir q, and with particles of constant settling velocity v_s, there exists a critical point on the water surface a distance M from the weir. A particle a, with settling velocity v_s, released at distance slightly greater than M, will describe under the influence of gravity and tank flow a path with reversed curvature (see diagram) and settle upon the bottom of the tank.* On the other hand, a particle b, with the same settling

*Neglecting currents induced by density differences, wind, and sludge removal mechanism, the direction of flow is taken radially upward toward the weir.

velocity, released at a distance slightly less than M, will describe a simple curved path and be carried over the weir in the effluent.

In case of particle a, the effect of the settling velocity transcends that of the radial velocity of flow toward the weir. With particle b the radial velocity overcomes the settling velocity. Between the two paths lies a critical locus (dashed line on sketch) representing the path of a particle of settling velocity v_s in which the effect of the settling velocity is exactly balanced by that of the radial velocity. Such a particle would approach the end of the tank at a distance N below the weir.

The locus evidently delimits a zone near the weir that has no utility in sedimentation; all particles of settling velocity v_s inside the zone (indicated by the dashed line) will be carried out over the weir in the effluent. All other particles of same settling velocity will be removed in the sludge. The effective volume of the tank, therefore, is the gross volume minus that within the critical locus. For particles of smaller settling velocity, the critical zone will be larger. Indeed, with slowly settling particles, M may exceed the length of the tank, and N the tank depth. Evidently such particles cannot be removed by settling.

In addition to settling velocity, flow per unit length of weir determines the size of the ineffective zone. If flow per unit length of weir is increased, the radial component of velocity becomes stronger relative to the settling velocity. Accordingly, particles at greater distance will be carried over the weir and the critical locus moves farther away from the weir crest, thereby reducing the effective volume of the tank. It is worthwhile to ascertain the volume of the ineffective zone for particles of size and density occurring in sewage. This may be done with the aid of the diagram shown below.

With reference to the diagram, it is seen that the velocity of the particle v may be resolved into horizontal and vertical components as follows:

$$\frac{dx}{dt} = v_r \cos \theta$$

$$\frac{dy}{dt} = v_r \sin \theta + v_s$$

The radial velocity v_r varies inversely as the distance r from the weir.

$$v_r = -\frac{2q}{\pi r}$$

where

q = flow per unit length of weir.

The distance N at which the critical locus intersects the end of the tank is located at a depth such that the upward velocity of the flow exactly equals the settling velocity of the group of particles under consideration. The report develops, by a series of formulas, the equations $N = q/\pi v_s$ and $M = q/v_s$. The volume per unit length of weir bounded by the critical locus is found to be $V = 0.441\ q^2/v_s^2$. In general, the ineffective volume for circular tanks, weir troughs and other conditions different from those assumed is represented by the equation $V = k\ q^2/v_s^2$, where k varies between 0.35 and 0.55.

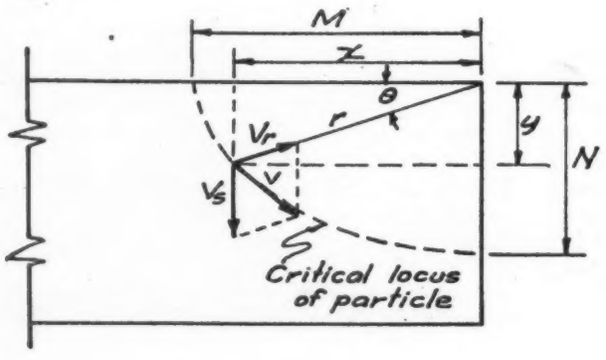
These equations for V indicate that the volume of a settling tank that is ineffective for settling particles of a given size range is a quadratic function of the ratio of the flow intensity and the settling velocity. If the flow per unit length of weir is doubled, then the ineffective volume for particles of a particular size is quadrupled. The same is true for all settleable particles—an increase in flow intensity reduces effective settling volume at a disproportionate rate.

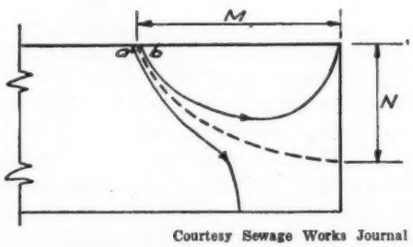
As an example: To determine the ineffective volume in a rectangular settling tank for sewage particles of average settling velocity due to upward flow toward a weir, assume that the average daytime flow is 35,000 gpd per lineal foot of weir = 195 cfh per lineal foot; v_s = 3 to 7 ft.-hr. Then V = 670 cu. ft. per lin. ft. of weir, and the critical zone would extend to a distance about 40 ft. from the weir and all the way to the bottom of the tank. At lower flows and for more rapidly settling particles, the ineffective volume of course is smaller. With slowly settling particles such as the light pinpoint floc sometimes noted in the vicinity of effluent weirs in activated sludge secondary tanks, the ineffective volume would be even larger.

To show the quantitative effect of flow irregularity, assume that, in the tank just considered, the flow is intermittent due to the action of pumps which operate only 50% of the time, causing no flow for 50% of the time and twice the average for the other 50%, the periods being 20 minutes long. The average value of the ineffective volume is calculated to be 1340 cu. ft. If the flow variation is gradual, reflecting water use variation with post routine ranging from 25% to 175% of the daily average, the ineffective volume is calculated to be 860 cu. ft., which is 28% larger than that for uniform flow.

Pay Rates for Sanitation Laborers

A recent survey of pay rates of sanitation laborers in 18 cities, made by the Bureau of Municipal Research in Philadelphia, shows that 12 cities pay street sweepers from 62½ cents per hour in Kansas City, Missouri, to $1.00 in Chicago and $1.06 in Milwaukee. All except one of the 18 cities allow from 10 to 26 days vacation a year with pay, 11 cities allow holidays with pay, and 14 provide pensions for such employees.—*Public Management.*





Courtesy Sewage Works Journal

Above: Critical locus at effluent weir; left: diagram for calculating critical locus of particle.

How the Camera Transit is Used in Survey Work

Combination of a special camera with a standard transit may be of marked advantage in mapping areas, especially those that are rough. Both horizontal and vertical positions of objects and contours can be located.

By REVERE G. SANDERS

The camera transit.

PHOTOGRAMMETRY has received so much impetus in the last ten to fifteen years by the advances of aerial photography that it is often forgotten that the principles of photographic surveying on the ground have been known for a much longer period. Actually, the science of surveying by terrestrial photographs has been known for half a century, and in the early nineteen hundreds, "terrestrial photogrammetry" and "the photo-theodolite" were by-words among European civil engineers. These impressive terms are characteristic of an European tendency to shroud anything technical with an aura of complexity and mystery. Terrestrial photogrammetry means nothing more than surveying and mapping with the aid of photographs which have been taken from ground positions. The word "photo-theodolite" has, in the case of the instrument recently produced by the Fairchild Camera & Instrument Corporation, been changed to the very plain but descriptive name of "camera transit."

How efficiently this method of surveying and mapping, which has in the past been used to good advantage and which is now receiving renewed attention, can be utilized by individual land surveyors, surveying and mapping organizations, or federal, state and county engineering groups, depends largely on local conditions. Its use, under proper circumstances, may bring about the following advantages:

(a) Effect considerably reduced costs in field work and decrease costs to a lesser extent in the office.

The camera transit set up in the field.

(b) Enable larger areas to be mapped at greater speed than conventional methods, particularly in rugged terrain where usual ground methods of surveying are difficult, and where there is physical difficulty in getting from one place to another, carrying equipment and measuring lines. This would best apply to public works, such as dam sites, highway locations in rugged areas, pipe lines, and irrigation projects (with irrigation control starting in mountainous regions).

(c) Provide a more even flow of office mapping work by virtue of the fact that one day of photography can produce enough work to keep an engineering office staff occupied for a considerable length of time. This levels out the slack periods which may arise from a protracted stretch of inclement weather that brings field work to a halt. Further, more office mapping jobs may be created by virtue of the fact that the field parties can send in greater amounts of data to be reduced to maps than is possible by present ground surveying methods.

(d) Eliminate the need for stadia rodmen to scramble around rugged country in the painstaking and often dangerous manner now necessary.

(e) Permit more extensive mapping for public works projects due to the reduction in cost of surveying and mapping, and the fact that large projects can be reduced to final map form more quickly.

(f) Permits the positions, both horizontally and vertically, of objects or contours to be located in the drafting room by a method of intersecting lines drawn on the photographs, taken from the different positions, of the points in question.

It is desirable for civil engineers interested in surveying and mapping to read as much as they can on the subject of terrestrial photogrammetry so that they may be in a position to evaluate its advantages, and to consider the procurement of the necessary equipment if they find that this method of surveying and mapping applies to their projects. Unfortunately, there has not been very much written on terrestrial photogrammetry in American publications. A bibliography at the end of this article lists the few American books

Close-up of plate holder and its attachment.

and publications which deal with the subject; but, even in these, that which is written on the subject often is made to appear very complex and highly theoretical.

This tendency results from the influence of European engineers in the field of terrestrial photogrammetry. The highly academic approach used in the European technical articles is of value to an engineering student in providing him with background for use in later professional life. For the practicing professional engineer, this academic approach to the problem is apt to cause him to close a book almost as fast as he has opened it.

Equipment and How to Use It

The basic instrument required in terrestrial photogrammetry is the camera transit, or, as the Europeans still call it, the photo-theodolite. As can be seen from the illustration, this consists of a conventional thirty-second reading Keuffel & Esser transit which has been reworked by the Fairchild Camera & Instrument Corporation to carry a specially designed and built camera.

The telescope of the transit has been mounted on top of the camera. In this form, the transit can still be used in the majority of cases for the same purposes that it would ordinarily be used if the camera were not involved. It is impossible with the installation of the camera to transit the telescope for the purpose of taking back sights. Nevertheless, horizontal and vertical angles can be read with as much ease as with the ordinary transit.

The camera is made of such materials that the needle of the compass will be unaffected, and is equipped with a very high quality 8¼" Goerz aerotar lens, having a F/6.9 aperture. This lens gives exceptionally sharp photographic resolution and is free from lens distortion which could be a source of error.

The camera contains carefully calibrated fiducial marks which are adjusted by the National Bureau of Standards in Washington, D. C. These are the reference marks from which all measurements are made in the course of the mapping from the photographic information.

The photographs are taken on glass plates in order to preserve the images from any possible error which might be caused by the shrinkage of ordinary film in the course of development or as a result of change in temperature or humidity.

The field work connected with a terrestrial photogrammetric survey consists of selecting stations from which all portions of the terrain to be mapped can be included in at least two photographs. This portion of the work calls for a certain amount of judgment which comes with experience with the method. The theoretical considerations in the selection of stations are simple but speed and accuracy will come only after a certain amount of field practice. These camera stations are tied in one with the other by triangulation, using either a conventional transit or using the transit portion of the camera transit. The elevations of the stations must be determined and the length of the lines between camera stations must also be known.

The photography itself is not difficult. The camera is pointed by means of the transit in the desired direction both horizontally and vertically and locked in that position. The horizontal angle and vertical angle is recorded for future use in the office. The diaphragm of the lens and the speed of the shutter can be set using ordinary photographic experience or by resorting to the use of light meters with which most people are familiar. The development of the glass plate negatives is a conventional photographic laboratory operation and presents no problem. The mapping work can be done most readily by working from contact prints made from the glass plate negatives.

Application of Terrestrial Photogrammetry

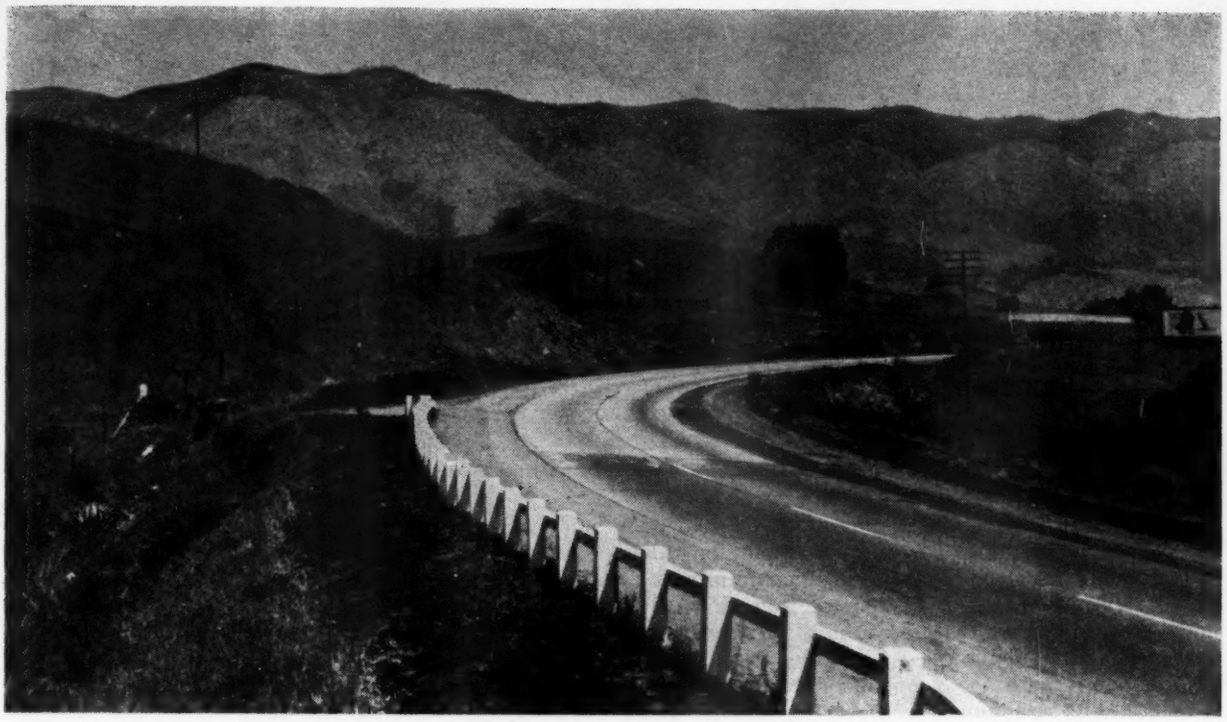
In the final analysis, it is the economic aspect of a method which usually controls its acceptance or non-acceptance. The experience to date in Europe, Canada, and the United States indicates that terrestrial photogrammetry applies best in mountainous areas or in rugged country where inclement weather is frequently experienced, to a degree that it interferes with ordinary mapping.

Generally speaking, the method is best suited to areas involving not less than several square miles although in a recent thesis written by L. S. Reynolds and A. B. Chilton, Jr., at Rensselaer Polytechnic Institute, the terrestrial photogrammetric method was used successfully on an area of only 93 acres of gently rolling terrain in an urban park area. According to the conclusions of these men, the terrestrial photogrammetric method proved to be more economical than producing a topographic map to the same standards by conventional methods. Other conclusions on terrestrial photogrammetry, reached by the Rensselaer men, who conducted their survey to satisfy their interest in this method bear quoting:

"The two of us made a 93-acre map, of lightly wooded territory, mapped to a scale of 50 feet to the inch, in 149 hours, or about 300 man-hours to do the 93 acres. Roughly, this is 3-odd man-hours per acre. It is definitely less than time required to do the job by transit and stadia, and probably a little less than the time in which it could be done by plane-table.

"We find that photographic surveying affords a rapid method of locating topographic details for construction of small-scale maps (say 2 or 3 miles to 1 inch). Best results are obtained where the country has characteristic shapes, and affords good positions for taking the views.

(Continued on page 33)



Firebreak behind guard rail.

How to Reduce Fire Hazards Along Highways

Timely data on methods used in the control of roadside growths to aid in fire prevention, as described in California Highways and Public Works.

By E. S. WHITAKER and H. N. BOSWORTH
Assistant Landscape Engineers, California Division of Highways

THE control of roadside growth to prevent fires is based on recognition of the need for a program for the protection of agricultural lands adjoining state highways against fires which may originate on the highways. The program is intended to minimize the number and spread of fires originating from traffic, either moving on the traveled way or parked on the shoulder area.

Fire hazard control work is undertaken along roadsides which adjoin pasture lands and grain fields where a fire originating on the highway would quickly get out of control. No work is done along sections of highways where adjacent land is cultivated, irrigated, or in orchards. Neither is work undertaken where barriers such as rivers, irrigation ditches, or railroads serve as a firebreak.

The program was first initiated in 1926 when extensive fire losses to crops caused underwriters to consider increases in premium rates for this type of insurance. The program had gradually expanded to take in some 3,000 roadside miles and requires approximately $120,000 annually to finance. This is in addition to work such as plowing firebreaks and burning undertaken by owners of property adjoining the highways.

Methods of control include the killing of green grass with a diesel oil spray and a follow-up burning after the sprayed grass has become dead and dry; and the control of vegetation by mechanical means—that is, through the use of discing or blading equipment. During the war years, with the use of diesel oil limited, a fair degree of control was obtained through discing and blading but due to the nature of the roadsides, there were many miles on which no control could be done. The return to the spray and burn work allows for a more complete control program.

Present practice provides for a control strip six feet wide when sprayed and burned, or the width of one operation if disced or bladed. The sprayed or bladed strip is on or as close to the shoulder as growth demands in order to increase the width between the edge of the traveled way and the nearest roadside fire hazard.

Blading Provides Economical Control

Blading, which provides the most economical control, is done on valley; turnpike, and rolling foothill sections with the bladed width placed on the shoulder to control the hazard growing nearest the traveled way. Blading is also carried out on narrow shoulders to afford additional control to the spraying and burning done on cut and fill slopes.

Heavy duty discs are used on areas outside of the gutter line on turnpike or valley sections, or in rolling foothill sections. The disced width is placed outside of but as near to the gutter line as physical features permit for the same reasons noted regarding the sprayed and burned strip. Discing is not undertaken between the edge of the traveled way and the gutter line, it being desired to keep the soil stable in this

Burned firebreak on a cut slope from the gutter line up.

area. Discing is carried out as near to the point of the cut slope as is possible. The sprayed strip along the bottom of the cut slope is extended either to meet the disced strip or is continued along the top of the fill slope, according to the nature of the roadside and the method of control determined advisable. In this manner, the danger of a fire escape at the transition areas is reduced to a minimum.

Valley, turnpike, and rolling foothill sections may often be disced or bladed with little danger of soil erosion, whereas other areas that are fairly level require treatment by spraying and burning in order to maintain soil stability. Spraying and burning provides the maximum of protection when placed from the toe of cut slopes up on the slope and from the top edge of fill slopes out and down. In undulating country, a most effective fire hazard control job may frequently result from spraying and burning on cuts and fills and discing or blading on the wide flat spaces between.

The determining of the desired method of control is governed by the width of the shoulder and right of way, the location of the gutter line, the nature of the soil, and the profile of the treated roadside.

A new method of establishing a fire hazard control strip along the roadside, which is expected greatly to reduce costs over the conventional spray and burn system, has been given a trial the past year. This method uses an inexpensive machine which consists essentially of a blower, powered by a small air-cooled engine, and a movable extended arm to which a burner head is attached. This machine is mounted on a two-wheel trailer which carries tanks for fuel oil which is used for heat. An intense flame is directed over a strip of grass as the machine is pulled along the roadside. This type of control is designed to be used on young green grass and weed growth. The searing action of the intense flame kills the plant tissues, and a second or follow-up burn removes the fire hazard. As with all other roadside burning operations, a water tank provided with high pressure pump should attend the work. It is anticipated that this machine, when somewhat improved, may prove especially valuable in mountainous areas where growth in the gutters and on cut and fill slopes on narrow winding right-of-way presents the greatest fire hazard.

Firebreak between cut and fill sloper.

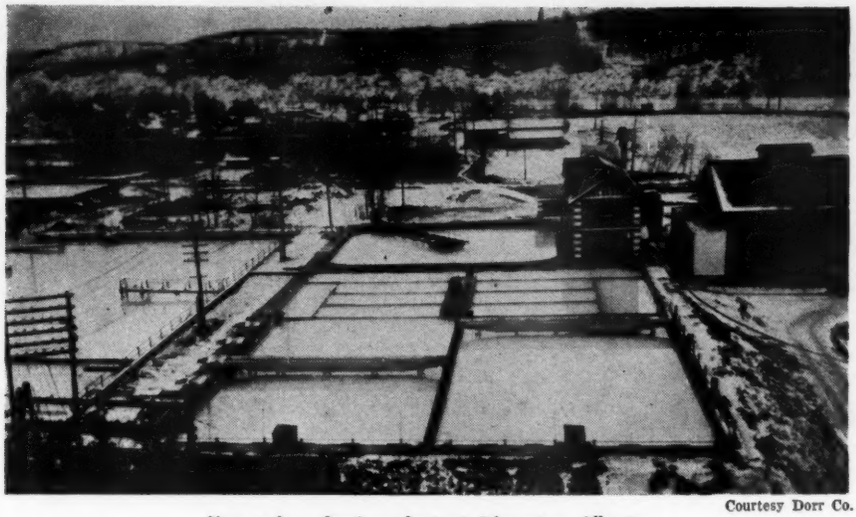
Some work has been done in the past to eliminate roadside growth by chemical applications or with soil sterilizing agents. This has not proved successful for general roadside use due to the cost of materials, the possible danger to livestock through poisoning, or because of unreliable soil reactions along any given roadside. Soil sterilization is practical, however, around guardrails, sight posts, bridge heads, structures, etc., and this practice is encouraged.

Many new chemicals have been produced in recent years which show promise as effective weed killers or soil sterilants. It is entirely possible that the present methods of roadside fire hazard control will become antiquated when these chemicals become commercially available within a price range which will justify their use as against present methods. A period of experimentation is always necessary in connection with such developments.

The benefits of the program from the public point of view are difficult to evaluate as the work is in the nature of insurance against loss. An uncontrolled fire leaves devastation behind, while a prevented fire leaves no record of fact.

The Effect of Insulating Layers on the Rise of Capillary Moisture in Heavy Loams

The results of investigations by a Russian, L. Mamanina, on this subject were published in Russian, with an English summary in *Pochvovedenie* (Moscow) [1944 (2-3)] and reported in *Road Abstracts*. Laboratory experiments on the effectiveness of insulating layers in preventing the rise of capillary moisture in heavy loams led to the following conclusions:—(1) Of the three types of material studied, gravel, sand, and compacted loam, the best results were obtained with a coarse sand (0.09 to 0.02 in.); a 0.8-in. layer of this gave complete insulation. (2) A 1.5-in. layer of gravel had an appreciable insulating effect if the material was carefully cleaned. Otherwise a considerable thickness was required, as was also the case with medium sand. (3) A layer of compacted loam could not prevent the rise of capillary moisture, but could hinder and delay it.



Courtesy Dorr Co.

Lime-soda softening plant at Edmonton, Alberta.

Water Softening

A discussion of the need for and methods used in water softening, prepared for the Northern Illinois Water Institute. Much of the factual information is based on chapter X of the Manual of Water Quality and Treatment (AWWA, 1940).

By **CHARLES H. SPAULDING**
Chemical Engineer, Springfield, Ill.

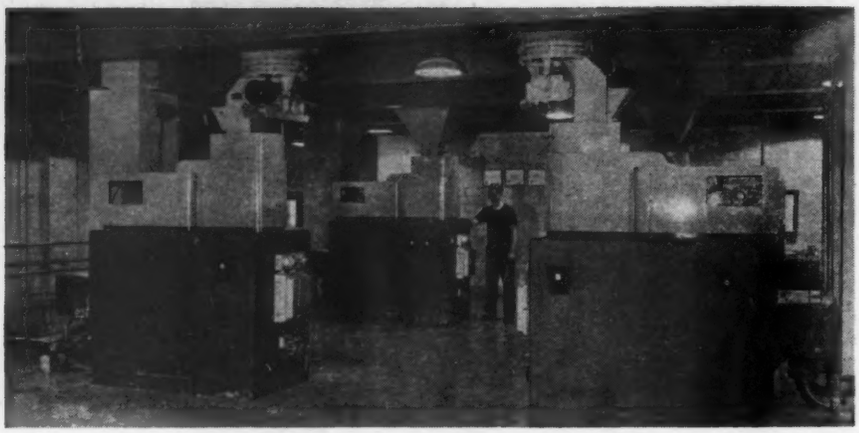
MOST water used for household purposes is softened before or during its use. It can be softened at home or at the waterworks. It has been found to be cheaper and better to soften the entire public supply on a plant scale than to soften it by the methods available in the household. This is particularly the case whenever the water supply requires treatment for other reasons such as palatability, color, clarity, iron removal or safety. In such cases the additional cost for softening may be very small compared with the improvement in the quality of the water and the economic advantage to the community.

It has been said that water is softened one way or another before it is used for cleansing. If this is not done at the waterworks on the entire supply, it must be done by means of soap, softening powders or individual softeners at the point of use. Soap is ineffective as a cleaner until the hardness of the water has been removed, for the soap combines with the hardness in equivalent amounts, producing insoluble soap curd until the hardness is removed. One pound of lime costing one-half cent softens more water than twenty pounds of soap at whatever price you must pay for it. If it costs twenty cents per pound, then the advantage of lime over soap as a softener is eight hundred to one.

Numerous studies of the economy of water softening with relation to soap have been made, especially at Columbus, Ohio, under the direction of Charles P. Hoover. One such study arrives at a figure of $8.55 per year saved by a hypothetical family of five due to water softening at the municipal plant. Since the average family water bill was only $9.00 per year, it appears that the soap saving would nearly pay the water bill. The estimate of savings was based on an assumed average of 1.2 gallons of water per capita per day completely softened in the home while the reduction of hardness at the plant was 164 p.p.m. If the etsimated saving was accurate when computed some years ago, it is probably too low now with soap scarce and replaced by substitutes of unknown price and value.

More interesting was an experimental spot check of an actual family of five in Columbus which seems to have been selected as typical of the average or at least a median group in the scale of living. Their water bill was 75¢ per month. They used thirty gallons of water per day of which about 27% was for cleansing purposes—1.4% for laundry, 7.0% for dish washing, 13.0% for bathing, 5.0% for handwashing and 0.4% unclassified. This family was supplied unsoftened water for a week during which they used 11.5 pounds of soap, while with Columbus softened water they used only 3.7 pounds per week, thus saving 7.8 pounds of soap per week. The family was using bar soap at 21¢ per lb. and flake soap at 31¢ per lb. but even at 20¢ per lb. the saving for the group would have been $80 per year. We may well question whether the housekeeper would have spent $9 per month for soap very long without doing something drastic about it. A water softener salesman would eventually have heard about her. It seems likely that the standard of cleanliness had been raised by previous experience with soft water.

Another study of water softening economy was made several years ago by Hudson and Buswell who attacked the problem with a different method. In this study, actual soap sales were determined in four cities of about the same size and character but having water supplies widely different as to hardness, ranging from 45 p.p.m. in Superior, Wisconsin, to 555 p.p.m. in



A battery of chemical feeders.

Chicago Heights. They found the annual per capita expenditure for soap ranging from $3.75 in Superior to $7.28 in Chicago Heights. Allowance had to be made for difference in the price of soaps in the several cities. On the basis of soap at 16¢ per pound, the cost would have been $4.68 per capita per year in Superior and $7.32 in Chicago Heights. It will be noted that these figures are considerably more conservative than either of the other two estimates. On the basis of these data, softening is worth about 50¢ per capita per year for each hundred parts per million of hardness removed. No doubt, recent soap scarcity would justify a somewhat higher figure. However, the soap saving will be found to cover the entire cost of water purification in many cases.

While saving of soap is the principal argument for softening a public water supply, there are others even more potent in special cases. For example, hard water deposits scale on boiler tubes and shells and on the coils of water heaters, reduces the heat transfer and increases the cost of operation. Even more important is the increased temperature of the metal as a result of the scale insulation. This means higher maintenance and shorter life for the equipment.

The Chemistry of Water Hardness

Hardness, broadly speaking, is anything in water which destroys or precipitates soap thus preventing the formation of a permanent suds or lather. Generally speaking, it is calcium and magnesium in ionic form which constitute the bulk of water hardness. Soap is an alkaline salt of a fatty acid, soluble in water and able to produce a suds or lather having good detergent properties. Calcium and magnesium displace the alkalies, sodium and potassium, from soap, forming insoluble soap curd having no cleansing value.

Calcium and magnesium can be removed partially or completely by four methods, viz: distillation, boiling, precipitation and ion exchange. The first two methods have limited application but the last two are broadly applicable to public supplies.

Lime Softening by Precipitation

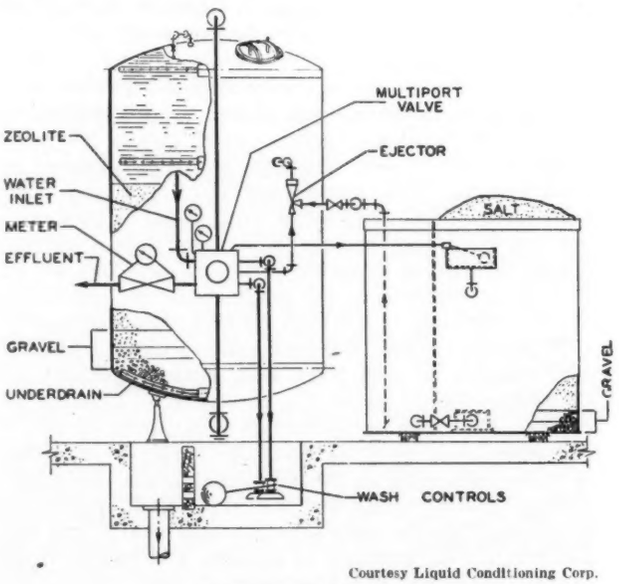
Softening by precipitation with lime and sometimes soda is the method most generally used for public supplies derived from surface streams or lakes. This method has several important advantages. In the first place, it follows the broad pattern of modern rapid sand filtration: add chemicals, produce a precipitate, permit it to settle and filter the supernatant. Surface water is often turbid and this is the accepted method of removing turbidity. Surface water often contains disagreeable odors and tastes for which activated carbon must be applied and later removed. For these purposes, the heavy precipitates of calcium and magnesium are most effective.

This type of plant, on an average, produces a safer water than the ordinary coagulation process, due in considerable measure to the voluminous floc, rapid settling and clear effluents which characterize such plants. The high pH at which the softening reactions take place has a slow bactericidal effect but this effect is probably not a determining factor in most plants, certainly not where pre-chlorination is used because high pH retards the sterilizing action of chlorine. Nevertheless, the net result of precipitation softening is a higher and more consistent removal of bacteria.

Equipment for Softening by Precipitation

Much of the equipment required for softening is standard for water purification plants and requires no special discussion. There are, however, some special problems, one of which is the disposal of sludge. This can be accomplished in many cases by pumping the sludge into simple drying beds or lagoons where the moisture evaporates or seeps away. The amount of area required varies with the amount and character of sludge produced. No rule of thumb for calculating the exact area would be reliable but an acre for each five million gallons plant capacity should be more than sufficient in most cases. The air-dried sludge may contain 50% moisture and is therefore not profitable to ship long distances. On the other hand, farmers within a ten-mile radius find it useful as agricultural lime.

In some cases it is satisfactory to discharge sludge into streams. It is inert and harmless to most forms of life although its color tends to arouse suspicion and in a small stream, the sludge bank may be unsightly. Methods of drying and reburning sludge for use as quicklime have been shown to be feasible but not suffi-

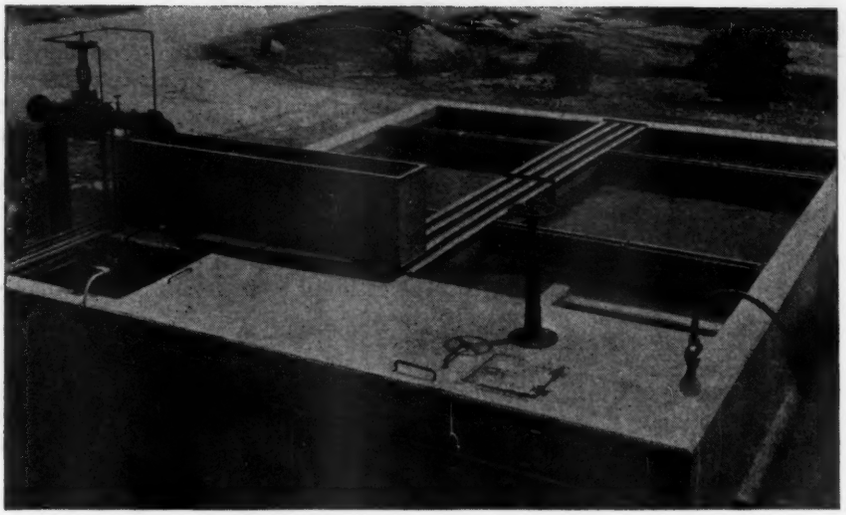


Courtesy Liquid Conditioning Corp.

Zeolite Water Softener.

ciently attractive to warrant their adoption at any water works in the United States.

Another special feature of softening plants has been the provision for recarbonation. This has been required because the softening reactions are seldom entirely complete. If they are far short of completion, they must be halted by reducing the pH nearly to the point of stability of the calcium. The optimum point for such pH varies in practice from plant to plant within a range of 8.0 to 10.0. In some plants, it has been found inadvisable to recarbonate the softened water. Rather, the filters are permitted to stabilize the soft water by contact with previously formed carbonate scale deposited upon the sand grains. The program in such plants is to permit the sand grains to grow in size and ultimately require replacement. Yet the additional softening accomplished in this way is most economical. A sand grain growing in size from 0.4 mm. to 1.0 mm. has increased its volume about fifteen times (assuming spheres). If a ton of sand removes fifteen tons of hardness, we have obtained softening at bargain prices because sand costs only half as much as lime which nets only about its own weight of hardness in the average plant. This phase of softening is entirely practical and feasible within modest limits of 5 to 10 p.p.m. It is necessary, however, to have high enough wash water velocities available to raise the heavier sand grains. Surface wash is believed essential to prevent caking of the surface and cementing of the grains. It is also necessary to condition carefully the water applied to the filters.



A Spaulding precipitator type installation.

Carbon dioxide, when required for recarbonation may be produced from gas, oil, coal or coke. In a thoroughly modern power plant where virtually smokeless combustion is maintained under precise control, the stack gas may be used for recarbonation. But unless these conditions are met, the water plant should be independent of the power plant stack. The equipment required is a suitable furnace or burner, scrubber, compressor and an absorption basin with a detention period of 20 to 30 minutes where the water is exposed to the gas bubbled through from a grid on the bottom.

Methods of Expediting Chemical Reactions

As previously stated, recarbonation is essentially a method of cleaning up residual precipitants. The need for recarbonation is proportionate to the incompleteness of the reactions. It was found in the first plants that the theoretical requirements of lime and soda would not produce a satisfactory plant effluent even after settling periods of several days duration. The first step therefore was to provide longer mixing periods and assist coagulation with alum or ferrous sulphate. It was also found that chemical reactions were much improved by overdosing the water above the theoretical requirements. This overdosing left an undesirable excess of chemical if applied to all of the water, and a modification was to split off part of the raw water to mix with the overtreated part and neutralize the excess chemicals, thus getting a major part of the advantage of overtreatment without any final excess. This method usually gives definitely improved results.

Another step was to return sludge from the coagulation basins to the freshly treated water. This was made possible by the adoption of clarifier basins with continual sludge removal. Its purpose was to provide a great area of sludge particles upon which the fresh precipitate was deposited just as it would otherwise do as it passed through the sand filter and the waterworks distribution system. Though this method tended to introduce odors and tastes as well as colloids, difficult to remove, it has been found useful.

The same desired effect of contact precipitation has been obtained in upward flow basins. Here the sludge is not permitted to settle but remains in suspension, each particle surrounded by fresh treated water supersaturated with precipitating compounds. The result is a very rapid approach to equilibrium, the reactions running virtually to completion in ten minutes in some cases, while the resulting size of suspended particles permits upward release of clear water. As a result of this departure in lime softening, the entire basin capacity including coagulation and settling can be reduced to that of the mixing chamber alone in previous designs. Furthermore, the effluent is far more stable than from the older type of plant.

The slurry or sludge suspension accumulated in upward flow basins varies as to concentration of total solids depending upon the relative proportions of calcium carbonate, magnesium hydroxide and coagulant which have been precipitated. When calcium carbonate alone is involved, the slurry is of such sandy consistency that it may contain 20% of solids and still appear quite thin. On the other hand, a slurry containing a high percentage of magnesium may be difficult to concentrate above 2% solids. Large quantities of coagulant behave similar to magnesium. The suspended solids are likely to vary from 1% to 10% in the slurry and from 5% to 20% in the concentrated sludge, depending on composition and operating conditions.

Cost Factors Influencing Softening

Softening practice varies in respect to the amount of hardness removed and the amount left in water at various plants. Without writing the reactions which may be found in any standard text, we may state the factors involved in a few sentences:—

(1) The cheapest and easiest hardness to remove is that part of the calcium for which an equivalent of bicarbonate radical exists in the raw water as shown by the alkalinity. This is the so-called calcium temporary hardness which requires a single equivalent of lime.

(2) The next in order of chemical cost is magnesium temporary hardness but this will require about twice the lime required in the first case.

(3) In the next bracket is calcium permanent hardness for which soda ash is required. The chemical cost is four to five times the first case.

(4) The highest chemical cost attaches to removal of magnesium permanent hardness which requires the sum of (1) and (3) for each unit of hardness.

There are many plants, perhaps most municipal plants, which use only lime for softening and are able to deliver an effluent not over 100 p.p.m. in total hardness. A few, not so fortunate, in raw water quality, require soda ash to obtain the same result. In general, practice, 100 p.p.m. came to be the standard effluent partly because of the difficulty of doing better. There is really no good reason why 100 p.p.m. should be the standard in newer plants in view of improved methods and equipment available, since a reduction to 25 p.p.m. is quite possible. While chemical cost may be considerably higher, total operating expense would be only moderately greater while quality would be notably superior if the hardness were further reduced.

A water purification plant represents a major investment requiring careful and thoughful management. Having made such an investment and provided the management, it would seem the part of wisdom to make the fullest possible use of the plant.

Zeolite Softening

The so-called zeolite is a class of sodium aluminum (or iron) silicates which has the ability to absorb calcium and magnesium from water, releasing at the same time an equivalent amount of sodium. Softening of water is accomplished by bringing it into contact with a bed of zeolite sand contained in a filter shell. As water is passed through such a contact bed, softening action continues until the zeolite reaches a saturation equilibrium. Then it must be regenerated by contact with a strong solution of sodium chloride. When this is done, the calcium and magnesium are displaced from the zeolite by the sodium of the brine. After the brine is rinsed out, the zeolite is ready for another softening cycle. The only chemical required for the softening is common salt and no chemical control is required other than to see that soft water is being delivered by the unit. This can be accomplished by a simple soap hardness test. Thus the zeolite softener is a device far better adapted to the needs of small users and the ability of unskilled operators.

Aside from simplicity, zeolite has other advantages. Hardness can be reduced to any desired minimum and the cost of operation per unit of hardness removed is independent of the anions present, that is, whether so-called temporary or permanent hardness is involved. The difference between calcium and magnesium is also of minor importance. Zeolite softening produces no sludge but on the other hand, the brine waste can be a nuisance. In fact, the total mineral waste from a zeolite plant is greater than from a lime-soda plant. In one case, it is a brine solution and in the other an inert solid. A zeolite softener may be operated as a closed system thus avoiding extra pumpage.

One reason why zeolite softening is simpler than lime-soda is that it does not do many of the things that are accomplished by the other method. It does not remove odor, taste, turbidity, color or bacteria. Its use presupposes a clear water which is satisfactory in all respects but hardness.

One of the chief disadvantages of zeolite softening for many purposes is that it leaves an equivalent of sodium for all of the calcium and magnesium removed, whereas, with lime softening the total solids are reduced by the amount of the temporary hardness which has been precipitated. For some technical purposes such as laundry, this makes little difference, but in a public supply it may detract from palatability and create a problem of stabilization against corrosion.

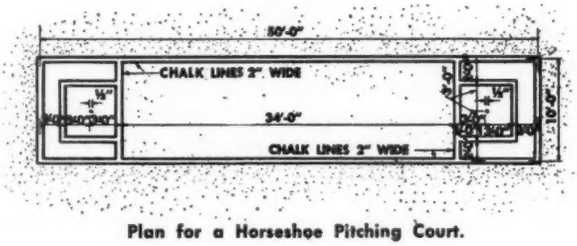
The cost of salt for the removal of temporary hardness is greater than the cost of lime for precipitation. On the other hand, the cost of salt is less than soda for the removal of non carbonate hardness. For these reasons lime and zeolite have been adopted in some plants as complementary methods. Lime is used to remove the temporary hardness. Then the filtered and recarbonated water is passed through zeolite to remove the permanent hardness. The hardness of the final effluent is controlled by bypassing some of the lime softened water around the zeolite softener and blending the two effluents in the desired proportion.

In any case zeolite softeners are particularly adapted to the removal of noncarbonate hardness and occupy an important place in water softening practice.

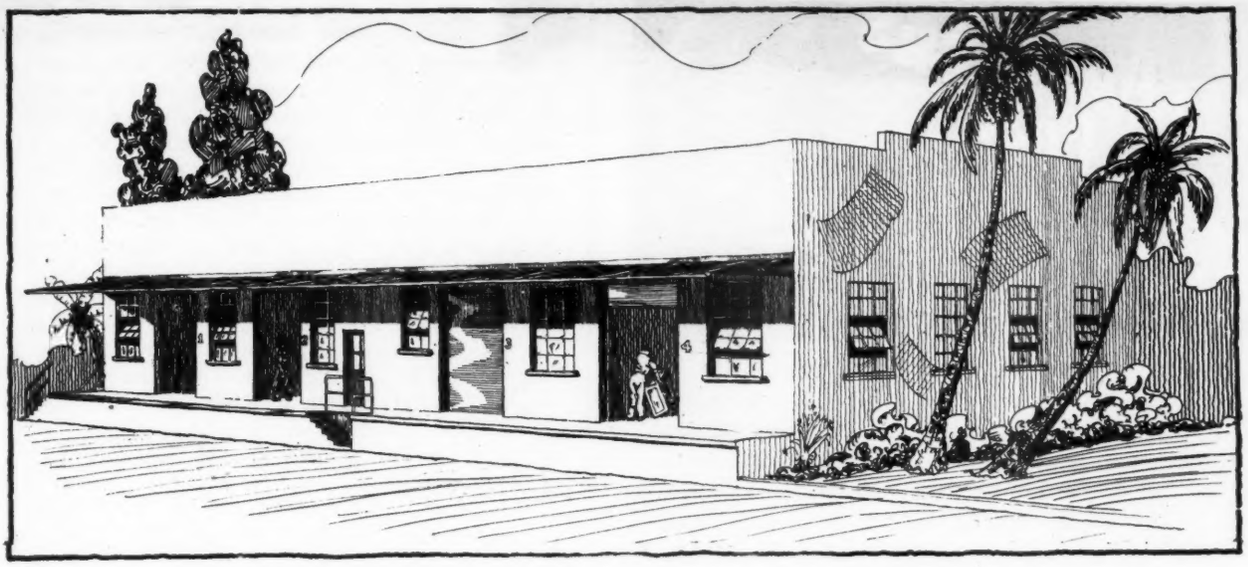
New Research Trends in Industrial Waste Disposal

One of the most difficult and wide spread problems in industrial waste disposal is finding means for the disposal of sludges obtained from clarification processes. Many of these are small in actual solids content but highly hydrous and resistant to common dewatering methods. Two developments show promise of aiding substantially in solving such problems. One is the possible use of supersonic vibrations. The ability of such vibrations to cause coagulation and reorientation of suspended particles as well as their destructiveness to bacteria has long been known but means of producing and applying them effectively were lacking. Development work carried on during the war has vastly improved methods of generation and application of the waves. Equipment is now under construction at Rutgers University which will be employed in determining the possible application of supersonic waves to paper mill wastes.

The second development which may prove of value is a new spray drying application which is capable of employing the waste heat of relatively low temperature stack gases together with combustion of the dried product to evaporate dilute sludges. The high volatile content of the waste solids of some types of mills may make the process very attractive from the heat balance standpoint. Both of these processes are of interest to, and are being followed by the National Council for Stream Improvement, to whom we are indebted for the above information.



Plan for a Horseshoe Pitching Court.



Proposed Kewalo Warehouse, Dep't of Public Works, City and County of Honolulu.

Inventory and Stock Control for City and County Public Works Departments

Essential factors in maintaining a properly functioning stores service. Though written primarily for sewage plants, and presented at a recent meeting of the British Institute of Sewage Purification, these data, as abstracted, apply equally to street, highway and water departments.

By W. F. FREEBORN and A. A. KIRKBRIGHT
West Middlesex Main Drainage Works

THE maintenance of a first-class stores service is essential for any works to function properly. It is of little use employing high-grade labor and an up-to-date plant if the materials for routine operation and repairs are not available when required. The right material at the right place at the right time is the essence of all good stores control.

Lay-out, Location and Construction

The initial lay-out of the store requires careful consideration. The construction must be such as to ensure the safe custody and protection of the stock, not only against pilfering, but also against damage by weather and contamination; to make the most effective use of the space available; and to minimize labor in the receipt, care and issue of goods.

The general lay-out of the plant will largely influence the choice of site for the stores building. Relevant factors are the control and supervision of all materials reaching and leaving the plant; ease of access for receipt and delivery; and reduction of time losses. If possible, all vehicles, both in and out, should have to travel over the same route, and that route should at all times be open to the view of the storekeeper.

A loading bank should be provided in the warehouse, with road access so that any normal type of vehicle can back up to the bank. This will enable materials to be transferred from bank to vehicle, and *vice versa,* with the minimum of effort. When the floor of the vehicle and the loading bank are approximately level, weighty packages which would otherwise need several men, or lifting tackle, to move can be handled by the truckman and storekeeper without additional help. A roller shutter door is a desirable refinement over the customary sliding door.

The loading bank should continue to the right and left of the doorway. Incoming goods can then be moved to one side for subsequent unpacking and examination, and on the other side materials for despatch can be assembled as they become available and held ready for removal.

An issue counter should also be provided, and should be on an inside wall of the building, if possible, so as to make it unnecessary for workmen to be subject to the elements when drawing stores. The door should be wide enough to allow for the passage of hand trucks, but should be so designed that it is always under the control of the storekeeper, and no one (not even the works manager!) should be able to enter the store without his knowledge.

With a loading bank and an issuing counter, the store is inevitably a draughty and somewhat dusty place, and wherever practicable a glass-walled cubicle should be provided in which the storekeeper can do his clerical work and keep his records.

Bins and Storage

Steel storage bins should be provided for small and medium-sized articles. The size and shape of the store must to a large extent determine the lay-out of the bins, but they should if practicable be arranged so as to afford speedy access to the stock while making full use of natural lighting. Adequate artificial lighting should also be provided for all the bins, otherwise much time can be lost by workers being detained while the storekeeper gropes in unlighted bins for small articles.

The bins should be so constructed that partition dividers can be removed at will to increase or decrease the size of compartments within a bin, thus providing for articles of varying sizes. For normal use, shelves capable of carrying a load of 30 lb. per sq. ft. of shelf area should be suitable.

Heavy or bulky stores should be accommodated in separate bays provided with racks or shelves capable of carrying up to 120 lb. per sq. ft. of shelf area. The practice of marking out bays and aisles on the floor and stacking goods thereon should be avoided whenever possible; it leads to an untidy and dirty store.

Special provision should be made for separate storing of commodities which are "good mixers" but "bad bed fellows," as cement and oils. Fire insurance companies do not view kindly the inclusion of an oil store in a general service building.

Storage bins, racks and shelves should not be fixed to the floor. In case changes may be found desirable in the arrangement of the store at a later date, these can then be made without difficulty.

It is an advantage if bins can be arranged in aisles and various categories of goods classified according to type. At the same time bins should be arranged so that goods in frequent demand are placed where they are most readily accessible, and heavy or bulky goods where the difficulty of handling is reduced to a minimum.

It may be necessary to maintain small subsidiary stores for such items as timber, iron and steel, brick, sand, pipe, etc., but they should be grouped, along with the gasoline and oil pumps, so as to be readily accessible from the main building.

The store building should be large enough to cope with the estimated maximum requirements of the works, with adequate lighting, heating and ventilation; and it should be provided with a dry level floor laid with non-slip, dustless and good wearing material.

Plant and Appliances

In workshops, power stations, or wherever heavy materials are handled, an overhead travelling crane should be installed. This statement might be thought to be stressing the obvious, yet it is amazing to notice how many weird and wonderful lifting contrivances have to be evolved because of the absence of proper and adequate lifting gear, and many a manager must have had qualms about allowing the use of blocks suspended from roof trusses for lifting purposes. A perusal of the illustrated catalogues issued by the manufacturers will show that there is an abundance of excellent lifting appliances available for almost every situation, and there is no reason why every plant should not be suitably fitted up in this respect.

[Further sections of this article will be published in and early issue, including: Accounting and indexing; ordering supplies; welfare; finance; costs; renewal funds; insurance; ancillary services; and staff and the future.—*Ed.*]

How the Camera Transit Is Used

(Continued from page 24)

"In fact, photographic surveying is best suited to regions not too thickly wooded, yet with enough scattered trees, structures, and characteristic contour shapes to give plenty of identifiable points. It must be admitted that a definite drawback to the photographic method is its lack of usefulness in country bare of prominent details, or so thickly wooded as to interfere with clear photography. But between these two extremes lies a considerable portion of the world which could be surveyed by these means.

"In our first attempt at photographic surveying, we have been convinced that it is easy to learn and carry out, and that many surveying offices could benefit by the use of this method and the purchase of equipment necessary for it."

The present cost of the camera transit complete, with its necessary accessories, would probably be 4 to 6 times the cost of a simple transit. This is due to the fact that the demand at this time involves such small quantities as to make it necessary to build up the instruments by hand to fill the individual orders that are received. If a more widespread demand should develop out of the renewed interest in this method of surveying and mapping, such that mass production methods could be used, a considerable reduction in sales price would probably result. For the average individual land surveyor the camera transit represents a rather considerable investment. For the larger surveying and mapping company or for a federal, county, or state mapping organization, the initial investment is less important. Moreover, it is probable that the cost of the equipment could be saved many times over and in a relatively short period of time if used under the right conditions.

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Michigan to Study Roadside Control

The need for control of the development of the roadsides along Michigan highways has been recognized by the Michigan State Highway Department and an active program to cope with this problem and

encourage preventive measures before the building industry resumes its pre-war volume has been initiated. The Roadside Control Unit of the Planning and Traffic Division will be responsible for the program of land use planning and traffic engineering as it relates to roadside control. The following items will be covered.

Discussion of land use and traffic hazard problems before groups interested in general planning, land use planning and zoning, to obtain local appreciation of the social and economic values involved.

A department sponsored and financed program to reduce roadside hazards along the principal State trunklines. Roadside enterprises with hazardous approaches will be encouraged to improve their facilities. The press and radio will be utilized.

Alternate clauses involving set-back lines and off-the-highway parking facilities, for zoning ordinances, will be presented for the consideration of local planning and zoning agencies.

Necessary records will be established to provide the materials for an analysis of before-and-after accident rates on routes improved under such a program of roadside control.

Selecting and Purchasing Deep Well Pumps

(Continued from page 18)

to carry the weight of the equipment and to absorb all shocks of pump operation and water hammer. No part of the pump weight should depend on the top of the well casing for support. If the pump is to be operated indoors, the pump house is generally built under a separate contract, and this contract would normally include the pump foundation, but not grouting the pump into position.

Following is a check list of items that may be included in the pump specifications:

A. *Well Data:* Diameter; amount of casing; amount of rock hole; details of screen; depth; inside diameter; plumbness; and, if available, a diagram of the well and results of gauging after the well was completed.

B. *Working Data:* Volume of water to be pumped; the working level; the head against which the water is to be pumped, that is, the pressure in the distribution system at the point of entry, and allowance for line losses.

C. *Pump Details:* The desired setting of the pump; the static level and drawdown; length of tail pipe and screen; size of pump column;* size of drive shaft;* bearing spacing; type of bearings, oil or water lubricated; size of enclosing pipe on drive shaft if oil lubricated;* type and material of impellers; type of thrust bearing; bowls, type, material and finish.

D. *Power:* Motor [horsepower;* maximum speed; voltage; phase, and cycles]; power source requirements (no load, full load, locked rotor, starting current maximum; starter, whether across the line or compensator); under-voltage protection and overload relays; standby drive.

E. *Controls:* Starting and stopping pressure for automatic control; automatic delay; manual control; type and size of control panel; electrical wiring required; meter board; furnishing entrance switch or circuit breaker and enclosing box; high or low pressure cut-outs; main switch on board, fused or circuit breaker; enclosed or open face controls on panel board.

F. *Equipment Details:* Gauges, system pressure (pounds or feet or combined); drawdown tubing; air pump, hand or power operated; pump pressure gauge; manometer; pressure snubbers on control and gauge lines; check valves, type as straight, balanced, cushioned, roto valve or hydraulic; gate valves, cast iron fittings, flanged or bell and spigot, and to what point; pump blow-off line; air release line; well vent; sampling tap for raw water; sampling tap for treated or chlorinated water; and point of take-off for operating automatic controls, as from distribution mains or other location.

The items marked * may be specified or left to the discretion of the bidder.

In making the test for efficiency, the pump contractors should be afforded every facility and allowed to use the equipment specified by the engineer, either that to be used in regular operation or special equipment. The amount of water discharged may be measured by a venturi meter, special orifice, weir or other accurate method. Gauges should be calibrated by a dead weight tester and allowances made for any corrections. An example of a test follows:

a. Gallons per minute pumped during test 250
b. Head pumped against:
Head below pump, water level to centerline of pump discharge ..... 200 ft.
Height of gauge above center line of pump discharge ..... 3 ft.
Head above pump, pressure gauge on discharge side of pump ..... 100 ft.
Total head ..... 303 ft.
c. Power required during test ..... 20 kw.

It is assumed that the two gauges showing head below pump and head above pump are on the same level; if not, a correction must be added for the difference.

The commonly used formula for water horse power or output of the pump is:

$$\frac{\text{Gallons per minute X total head}}{3{,}960} = \frac{250 \times 303}{3{,}960} = 19.1 \text{ hp.}$$

The power input is kw ÷ 0.746 = 20 kw ÷ 0.746 = 26.8 horsepower.

The wire to water efficiency is 19.1 ÷ 26.8 = 71.2%.

Ditch Retards to Prevent Erosion

(Continued from page 20)

of cut-back asphalt to the cubic yard of select material, loose measurement, making a residual content by weight of about 5.75%.

It is believed that plant mix stabilization of the type described above is suitable and economical where local base materials are not available. Results indicate that sandy material as well as material containing low percentages of gravel can be stabilized satisfactorily by this method. In most cases, this stabilized shoulder should be protected by a light asphalt seal coat.

The sources from which the material for stabilization is obtained should be designated by the department after adequate laboratory testing.

Road Mixed Stabilized Shoulders.—We have stabilized the shoulders on many miles of our highways by road-mix methods, especially on sections where the material was a very sandy loam soil and, in places, a blow sand. Both road oils and cut-back asphalts have been used with good results.

The material on the shoulders is thoroughly pulverized by sprinkling, discing and rolling after the shoulder has been scarified to the specified depth. The bituminous material is then added and mixed thoroughly until a uniform mix is obtained. Approximately 1.0 gallon of bituminous material is used per sq. yd. for each inch of compacted thickness. The use of a disc harrow for mixing has been found to be a great help, and has reduced necessary blade operation. The mixture is laid down evenly and compacted by rolling. The surface is bladed lightly each day until the surface remains smooth and firm under traffic.

In most cases, we have placed a light asphalt seal coat on these stabilized shoulders.

Public Works Digests

Water Supply • Sewerage • Highways and Airports

In this section are digested and briefed the important articles appearing in the periodicals that reached this office during the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each digest refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Waterworks Digest

Control of Erosion

In 1941 it was estimated that 21% of the nation's 2600 impounding water supply reservoirs would have a useful life of less than 50 yr. as a result of erosion, and another 25% less than 100 yr. In a study of water treatment plants in North Carolina it was estimated that an average reduction of 25% to 30% in the suspended load would save $1.50 per mil. gal. in cost of chemicals, and result in an eventual over-all saving of $7 per mg as a result of smaller capital outlay for settling basins, filter plant units, power, labor and other costs for backwashing the filters and cleaning settling basins.

Control of erosion can be brought about by purchase of the watershed if it is a small one. But if the watershed is large this is generally impracticable and a contract may be made with the owners by which their lands will be adequately improved, protected and managed while remaining in their possession. This is best effected by having the owners organize into Soil Conservation Districts. As of February 15, 1946, there were 1467 such districts embracing 808,000,000 acres of land.

Water works operators can expedite soil conservation by employing full-time soil conservationists to aid such districts in farm planning and installing erosion-control structures. They can purchase land where adequate treatment by individual owners cannot be obtained; they can furnish districts with funds for types of treatment which individual farmers cannot well carry out, such as grassed waterways, gully control work, control of stream bank erosion, dams for soil saving or channel control, sediment detention basins, roadside erosion control, planting of abandoned gullied land. In carrying out this work, labor can be used that is permanently employed by a town or water company but have occasional days when they are not needed; and the same with equipment such as bulldozers, ditch diggers or trucks.[A130]

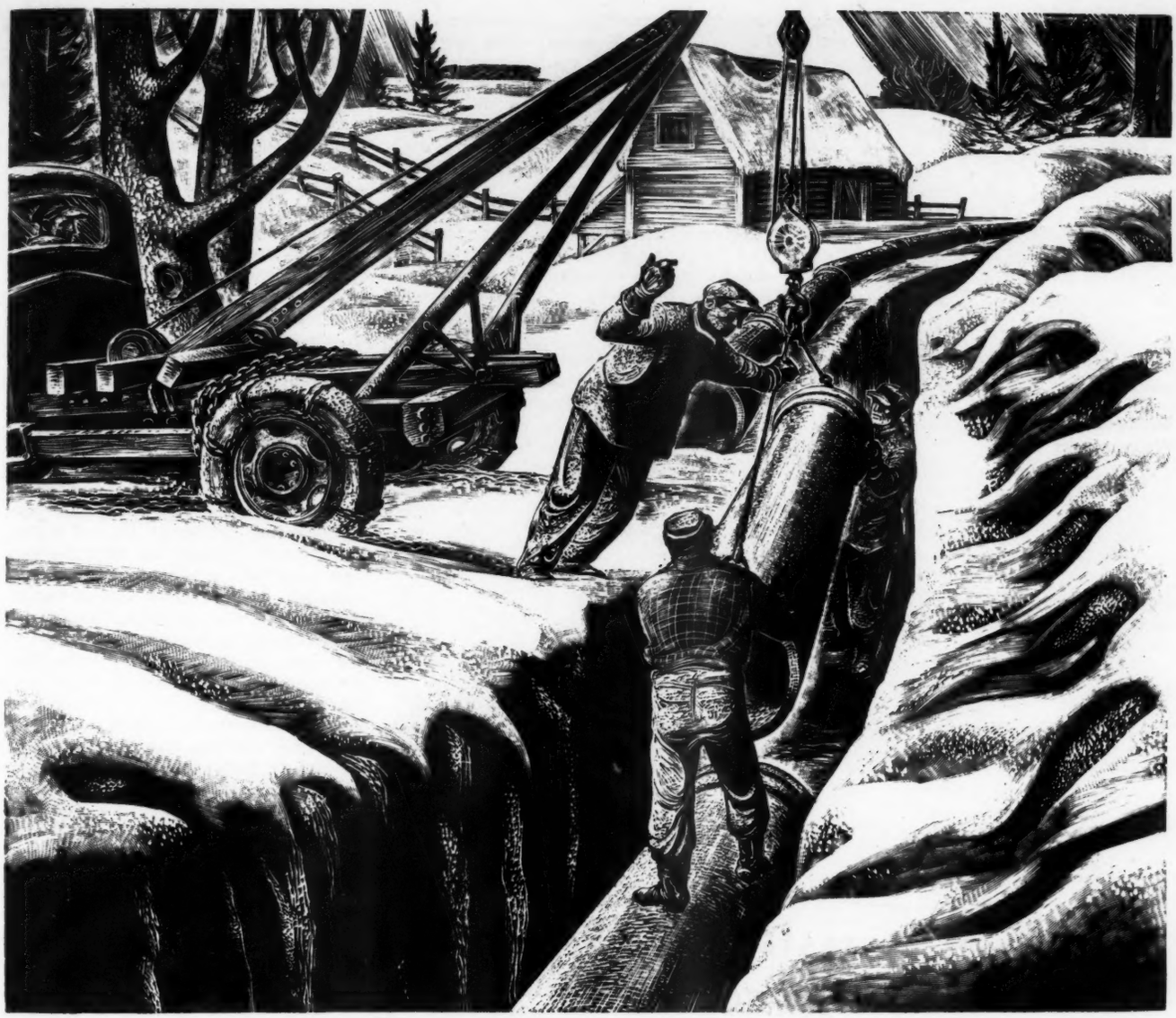
Courtesy Journal AWWA

Soil Conservation Districts in the U. S.

Public Use of Reservoirs

The proper extent of public use of reservoir lands and waters can be determined only after careful study of the individual reservoir in the light of the public relations, social, economic and health and sanitation factors. The economical production of a safe and satisfactory water supply is the prior consideration, to which purely social values must be subordinated. Public use may be interpreted to include the development of resorts, boating, bathing, fishing, camping, picnicking, hiking, nature study and similar recreational and educational activities. In deciding for any particular case what public uses may be justified the following criteria may be considered:

1. The public use must be consistent with the economical production of a safe and satisfactory water supply. Where water supplies are unfiltered, public use generally should be restricted, if not completely prohibited. Where supplies are filtered, a much more liberal policy may be followed, and often many desirable recreational and educational uses permitted.



Original Woodcut by Lynd Ward

It is probably cold comfort to a construction crew, on a winter morning, to realize that the cast iron supply line they are installing will bring needed protection to the safety and health of a community.

Long range planning for adequate water supply logically includes long-lived cast iron mains. Their reliability and low annual cost are proved by century-old pipe, still in service, even though made without benefit of the improved methods by which U. S. Cast Iron Pipe is produced in our modern plants.

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2. All public use of reservoir lands and waters which is permitted should be such as to result in a definite community benefit.

3. If consistent with other limiting factors, public use of reservoir lands and waters quite properly may be permitted as a means of improving the relations of the water utility with the public.

4. The cost to the utility of extending and controlling worthwhile public use of reservoir lands and waters must be commensurate with the benefits accruing to the utility. The prime function of the water works is to supply water and not to extend community service.[A131]

Research in the Waterworks Field

Research has been the keynote to success in every major industry and should be in the waterworks field. But there is needed a coordinating agency in which sanitary engineers may serve to guide other scientists in scientific research and development work. The author discusses numerous opportunities for profitable research, among them the following. Use of hydrology for prediction of available supplies. Use of chemical or other means for controlling aquatic vegetation in streams and reservoirs. Protection of reservoirs from pollution by sea gulls. Preventing entrance of fish at intakes. Preventing troubles caused by frazil ice. Application of knowledge of soil mechanics to flow of underground water. Applying to coagulation the disclosures of physical chemists and the use of activated silica and other chemicals. The use of weighting materials to increase settling velocity of floc. Up-flow type of coagulation and settling tanks. Adapting diatomaceous filters to use in municipal plants. Modernization of rapid sand filter plants. The use of synthetic resins for water softening. Use of ozone for removing tastes and odors. Investigation of types of activated carbon other than those now used. Mixing chlorine in water to increase its effectiveness. Use of chlorine dioxide in removing taste and odors. Use of halogen compounds for disinfection. A device for preventing backflow with absolute certainty. Electronic methods of measuring flow in pipes. A method of lining small mains that does not require disconnecting the services. Treatment of water to make it non-corrosive, without affecting its potability.[F72]

Watershed Maintenance

The Directors of the American Water Works Ass'n in 1945 established a Committee on Watershed Protection and Maintenance, which functions through sub-committees on forestation, on erosion control, and on policies for the public use of watershed areas. At the 1946 annual conference of the Association, the committee submitted its first report, accompanied by several papers on forestation and erosion control, abstracts of which are given below.

Concerning forestation, the committee said that efficient results demand operation under a policy projected over long periods, often 50 yr. or more; and a municipality or water board is ideally constituted for such work. It benefits from this use of its watershed, not only by the financial returns that will come in time, but also from the favorable effects on stream flow, the creation of an attractive setting for streams and reservoirs and, with certain limitations, the provision of recreational areas.[A126]

Returns From Forest Lands

The best method for estimating the returns from forest lands is to apply the average growth per acre per year over a long period of time. This of course varies greatly for different species of trees, sites, and methods of treatment. In the forests owned by the New Haven, Conn., Water Co., hardwood stands composed principally of oak may be expected to produce an average of 200 fbm per acre per yr.; hemlock, 350 fbm, white pine and Norway spruce 600 fbm and red pine 500 fbm. The average stumpage value of the timber, pre-war prices, is $7 per 1,000 fbm, giving the mean annual

gross returns from $1.40 to $4.20 per acre per year. The costs for intensive private forestry per acre per year are estimated to average from 37 cts. for longleaf pine to $1.13 for eastern white pine, the items for the latter being 60 cts. for taxes, 5 cts. for fire protection, 10 cts. for protection against insects and diseases, 15 cts. for cutting, 17 cts. for stand betterment (for western forests only 1 ct. is estimated), planting 4 cts., other items 2 cts.

Few if any water companies derive this much revenue from their forest land for several reasons. The growing stock of trees is inadequate in size, kind and quality merchantable for timber. The forestry operations are not conducted with primary reference to cost; the men used on it, both laborers and foremen, are frequently those employed regularly on water supply maintenance and are unskilled in woods work. Frequently more clean-up work is done than is necessary for timber management.

In general the advantages of forestation are: a larger net revenue than is obtainable by any other use consistent with proper sanitation of the watershed; it furnishes work for permanent employees who would otherwise be temporarily idle; and it furnishes effective protection against erosion and silting, increases the rate of infiltration into the soil, lowers the peaks of runoff and yields cooler water.[A127]

The effect of forests on the total quantity of available water supply is not definitely known, but it is not an important factor. Forests use water—some species 3 to 5 ft. of rainfall a year, others only 6"; the rate of use varies from month to month. The branches and foliage catch and hold appreciable quantities of water, much of which is promptly evaporated into the air. This interception loss may amount to 6" or more a year. On the other hand, forests greatly reduce evaporation from the soil. They protect it from erosion. They improve the physical, chemical and biological conditions of the soil, greatly increasing the infiltration and storage rates. They protect the soil from frost; in the spring the forest soil is free of solid ice long before soil in the open, permitting melting snow to infiltrate.

Among questions to be considered from the standpoint of water supply are: To what extent should the watershed be opened to public use? Should pine or spruce be favored over hard woods? What kinds should be grown about the shores of reservoirs? Which are preferable—large trees or dense forests of small trees? Should wild life be protected? Should roads and trails be permitted?

No operations, practices or developments can be permitted or condoned which in any way tend to cause either the physical removal of the soil, or a breakdown of its internal structure. Desirable rates of infiltration should be maintained to prevent or minimize destructive surface runoff from storms. Maintenance of the soil's optimum

water-holding capacity is essential. Such capacity is increased by the root development of dense undergrowth.

The draft upon soil moisture of heavy transpiration, which reduces reservoir inflow, is greatest along banks of streams and reservoirs, and cutting vegetation from the immediate vicinity of these has increased summer yield to a reservoir by 5 to 10%. Where the soil is shallow or erosive, the trees should not exceed 6" or 8" in diameter, cut material should be allowed to rot on the ground, and no logging roads should be permitted. On deep, porous soils trees may be grown to 24" diameter and cut material removed. The above apply chiefly to small watersheds. In the case of large ones, the aim should be the maximum of surface runoff in the shortest time without producing erosion. Where the water is obtained by wells from under the surface, the source areas should be managed with a view to reducing runoff to a minimum and aiding infiltration by developing good humus conditions. Where snow is a major source, hardwoods are desirable as they do not intercept the falling snow.[A128]

Pumping Against a 3150-Foot Head

A pumping plant in Grand Canyon, Arizona, operated by the A. T. & S. F. Railway Co. to furnish water for its hotel and locomotives, raises water through 12,000 ft. of 6" pipe against a static head of 3150 ft. The original plant, installed in 1932, consisted of four vertical centrifugal, 17-stage pumps, turbine type, operating in two units, each containing 2 pumps in series, with a capacity of 85 gpm against 3300 ft. head. At present there are one set of 85 gpm 17-stage pumps with 60 hp motors and one set of 160-gpm 14-stage pumps with 100 hp motors. The plant is operated from the power house on the canyon rim by push buttons, using a supervisory control system, alternating current being supplied at 2300 volts, 60 cycles. The plant receives no attention except visits from a service man once in two weeks. Should the water become silty, a photo-electric cell operates hydraulic valves automatically to divert it from the pumps. As the temperature sometimes goes to 20° below zero, a thermostat in the pipe just below the rim rings a bell and lights a signal in the power house before the water reaches freezing temperature, enabling the operator to start up a pump to put the water in motion. No leaks have ever been found in the pipe line, and no sign of depreciation in the pumps that normal maintenance could not take care of.[G46]

Salt Water Infiltration at Wells

The contamination of underground fresh-water aquifers by salt-water infiltration has become a serious problem in the Baltimore industrial area and other areas. The salt water is leaking into both producing and abandoned wells from overlying formations in the fresh-water strata. This leakage generally occurs through the space between the well casing and the borehole and may be stopped by filling this space with cement slurry.

This leakage may at first seem impossible, since almost all wells are drilled through clay beds. However, it has been shown by the use of caliper logs that the actual diameter of a drilled well usually is considerably larger than the diameter of the bit, producing an annular open space outside of the casing. One method of applying cement slurry to an existing well is to perforate the casing at the depth where the slurry is to be applied and force the cement through the perforation.

When a cement slurry is placed in a well in contact with a porous formation, the water in the slurry will be filtered from it when the pressure differential is toward the sand. If the coefficient of permeability of the sand is less than 3,000 gal. per day per sq. ft., the pores of the sand will be too small to allow the cement grains to enter. If the permeability is greater than this quantity, some of the cement may pass; but, since the water in the slurry may filter at the same time, the entire quantity of cement will not always move into the formation.

When a sand has a permeability of

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 63-65*

less than 3,000, the pressure will force the water out of the slurry leaving a filter cake upon the sand surface. To give an exact description of the conditions at any instant during the filtration process, the filtration equation for cement slurries was developed.

A study of the sands having permeabilities greater than 3,000 showed that three factors mainly controlled the amount of cement penetrating into the formation:

(1) The ratio of the pore size to the cement particle size;
(2) The slurry concentration; and
(3) The manner in which the pressure was applied.

Calculation of the pore diameters showed that the pore of the largest sand which would not permit the passage of a cement slurry was small enough so that two or three cement particles could form a stable bridge across the opening. No amount of pressure could be expected to force the cement into this sand. When the pores are larger, some of the cement will pass into the sand. If the slurry is thin, all the cement may penetrate; but, if the slurry is thick, the water may filter from it too rapidly to carry along all the cement particles and a filter cake will result. By using this principle, a slurry cake may be formed on a sand with a permeability as high as 127,000.

The speed with which the pressure is applied will determine the amount of cement that will penetrate. If the pressure is applied instantaneously, a greater quantity will pass than would pass if the same pressure were applied slowly. With a slow rate of pressure application, the slurry may cease to penetrate long before the maximum pressure is reached, so that high-pressure differentials are of small importance in such a case.

Under no circumstance is there any justification for using a blanket rule for the selection of the slurry concentration as has been attempted by many writers. In some cases the slurry may be very dilute, the excess water serving only as an agent to carry the cement into position, after which it is squeezed out and the cement particles are compacted. The initial slurry concentration will have no bearing on the volume, strength, or permeability of the final product. In other cases, it may be desirable to grout off a given formation without allowing the slurry to spread over other strata. In these circumstances, it would be desirable to use a thick slurry and a high squeeze pressure.[K5]

Municipal Organization

A committee of the A.W.W.A. has been studying the subject of top management in water works and has presented a preliminary report. It says: "Good management results from continuity of policies on expansion of both facilities and operations, from sound financing, efficient administration and good service. It is as essential for small plants as for large waterworks systems. Its functions must include sound planning for the future and the coordination of needs, plans and accomplishments with the financial obligation and ability to support them. It requires the development of a vital routine which will carry forward an orderly program with adequate assurance that future developments will largely be provided for as they arise."

In response to questionnaires sent to 590 waterworks organizations, 255 have returned them so far. Of these, 36% operate under a separate board or under a commission form of government; but there are many successful examples of other forms of management. The committee believes that "the first and foremost requirement for good management is a set of sound basic laws of the political division under which the utility operates," and has prepared outlines of possible local legislation, for an independent board and for a department of the local political organization.[A144]

Oil Lines on Watershed Areas

Breaks in petroleum products pipelines on watershed areas have occurred with disturbing frequency and their presence in such areas is a definite threat to water supplies; so serious a threat that some legislation to bring

such pipelines under more adequate control is needed. Perhaps this power should be given to the health departments of the various states. If such lines can not be excluded, the operators of them should certainly be bound by contract to recognize the rights of the water utility.[A145]

The Mode of Action of Chlorine

The most remarkable feature of the bactericidal action of chlorine is the low concentration at which it is effective. Biochemical action at what may be called the trace level of concentration is most readily explained in terms of effects on enzyme systems.

Employing the technics of physiological chemistry to determine the manner in which chlorine exercises its bactericidal action, the authors show that the trace level at which chlorine is effective implies that it must inhibit a key enzymatic process. This process is determined to be the oxidation of glucose by the bacterial cell; once the power of glucose oxidation is lost, the bacterial cell dies—the suspension becomes sterile. The authors further show that the reaction is not reversible; that is, that bacteria once inactivated by chlorine cannot be reactivated. They show that another halogen—iodine—has the same power, but requires higher concentrations for equivalent bacterial kills.[A147]

The discovery of the mode of action of chlorine suggests an application in determining the concentration of active chlorine in drinking water. The sensitivity of the triosephosphoric enzyme to chlorine in a very low concentration suggested the use of this enzyme for that purpose; but such use presents practical difficulties, and the authors used papain, a proteolytic enzyme, as a reagent and describe a procedure for such use.[A148]

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The Sewerage Digest

Controlling Pollution of Wisconsin's Streams

For the purpose of carrying out the State's stream pollution control program, the Wisconsin Committee on Water Pollution divided the state into 28 major drainage areas, each treated as a unit in carrying out a uniform plan, in which the gaining of intercommunity cooperation is aimed at. So far nearly all of Wisconsin's leading cities—14 of more than 3,000 population and with a combined population of 130,000 in 1940—give their sewage and trade wastes at least primary treatment. The conception and development of the water sanitation program involve interdependent technical, legal and economic phases. Uses of the streams for domestic supplies, irrigation, fishing, industrial uses, disposal of wastes, navigation and recreation must all be considered. As to industrial wastes, the effort is to establish cooperative programs to reduce wastes at their source, by utilization if possible; and, if this proves inadequate, to secure the development and installation of practical and economical methods of waste treatment and disposal.[X26]

Bio-Filtration At Keesler Field

Bio-filters have been operated for several years at Keesler Field, Miss., and a study made of the effects of variations in operating procedure. The results obtained by the details of procedure finally developed were better than had been expected. The ratio of recirculation needed for efficient operation was at least 2:1. Filter flies were controlled when the rate of application to the filter exceeded 12 mgad. Rate of application of BOD to the filter does not appreciably affect operation within the range of 0.2 to 1.4 lb. of BOD per cu. yd. per day. Maintenance of even distribution of sewage on the filter is essential. When detention time in the primary clarifier is greater than 3 hr., BOD removals decrease while there is very little increase in suspended solids removal. Rate of application to the filter, recirculation ratios, and detention time in the clarifiers are of utmost importance.

Originally the distributor arms had narrow flat plates the entire length of the arm above and below the orifices. By removing the top plate and substituting a bottom plate cut in scallops with the outside edge turned up, better distribution

Courtesy State Board of Health

Major drainage areas in Wisconsin.

was obtained and the suspended solids removal increased 23.4% and the BOD removal 19.8%.[G26]

Waste Waters From Farm Premises

Finding it desirable to treat the waste water from some farming communities which included washings from cow sheds, investigations were made in England to learn how much pollution from cow shed washings to allow for. In one case, where liberal amounts of bedding were used and the maximum possible quantity of solid manure was collected from the stalls and yard, the BOD in the washings per cow was approximately equal to that per person in domestic sewage. In another case where not so much care was taken to preserve the excretory matter, the BOD was three times as great.[D54]

English Design of Sedimentation Tanks

Capacity of sedimentation tanks is much less important than detail design. At one time English designers seldom made the capacity less than 10 hr. dry weather flow, while American tanks of 2 hr. capacity give fair results. The inlet detail is the most difficult. If the sewage enters through a bend, the greatest velocity and heaviest suspended solids will follow the outside of the bend, and either a conical, a concave or a plane baffle centered opposite the opening would throw the heaviest sedimentation burden in this direction. Of these, perhaps the best is a plane baffle tilted at an angle determined by experiment. Or the bend may turn upward into a baffle box. Good results have been obtained with a long, straight entrance pipe with a baffle at its outlet.

The tank outlet should always be a weir, of such length that the depth of flow over it does not exceed ¼" at the maximum rate, nor be less than 0.1". Near the outlet end of a tank, return currents on either top or bottom of the tank occupy ⅔ of its depth. In final sedimentation tanks of an activated sludge plant the return current is always at the top, and it is therefore advantageous to place outlet weirs across the tank near its mid-length. In some central-inlet radial-flow tanks, channel outlet weirs have been placed away from the sides.

In proportioning either horizontal-flow or upward-flow tanks, surface area is more important than cross-sectional. In horizontal-flow tanks, part of the length is used in dissipation of eddies and reduction of velocity, leaving the remainder for sedimentation. For upward flow tanks, a surface area that gives a maximum upward flow of 4 ft. per hr. is suggested. As to minimum depth of horizontal flow and relation of cross velocity to upward velocity, there are probably optimums but they have not been determined.

Inlet channels should insure, at maximum rate of flow, a velocity of not less than 2½ ft. per sec. and a depth of flow of not less than ½ the width. Outlet channels should give a velocity of at least 2 ft. per sec. Uniform distribution of sewage to several tanks can be obtained by weirs if there is available head; cutwaters seldom give even distribution and they tend to catch rags and paper. A reliable method is to make the lengths, diameters and gradients of the feed pipes or channels all equal in every respect.[H44]

Treating the World's Greasiest Sewage

Bradford, England, is the center of the wool-washing industry of that country, and its sewage contains an average of 890 ppm of grease, with peak flows equaling twice this. Moreover, the grease is in an emulsified state. Most of the grease is recovered from the sewage and sold, the proceeds in 1945-46 amounting to about $750,000 for grease and grease

products and $85,000 for fertilizer. By-products manufactured from the grease include stearine, oleine, pitch, lubricants, soap, rust-preventives and oils and wax used in paints and polishes. During the past 40 years the receipts have totaled about $13,000,000.

Sulphuric acid is added to the screened sewage to crack the emulsified suds, and the grease settles with the sludge in the precipitation tanks. The sludge is boiled with sulphuric acid in vats and pressed in filter presses, and the sludge cake matures for 6 to 12 months in open dumps, being turned over by grab buckets from time to time. It then is ground to a fine powder for fertilizer. The hot liquor from the presses is led to tanks, where the grease is removed and the water pumped into the raw sewage.[Y6]

Biological Detection Of River Pollution

The dissolved oxygen content of a stream is not always a certain indication of its purification. The Tame river is heavily polluted, the ammoniacal nitrogen being abnormally high throughout. The oxygen content at Castle Bromwech is fairly satisfactory (61%), and falls and rises gradually down stream. But there is no *Cocconeis* nor *Chamaesiphon* at any point and even sewage fungus is not abundant. Where a trade waste entered the river, began several miles almost barren of all biological forms, although the dissolved oxygen was fairly high, as was the ammoniacal nitrogen. It was believed that the trade waste contained copper, which poisoned the bacteria. Since decomposition of organic matter, and the consequent absorption of oxygen, is mainly bacteriological, the continued presence of dissolved oxygen undiminished is thus explained; also it demonstrates that the presence of metallic salts may greatly delay decomposition of sewage impurities; also that this effect is not shown by DO examination, but is indicated by biological examination.

The degree of purification at different sections of a stream is shown by such examination. On the entry of sewage effluent to a stream, the normal fauna is replaced by Tubificids and red Chironomids, the normal algal flora is much reduced and the dominant plants are members of the group of organisms called "sewage fungus," of which *Sphaerotilus natans* is the commonest. No matter what species make up the original river flora and fauna, the above are invariably dominant after pollution. Pollution is almost always accompanied by a deposit of black silt, a low dissolved oxygen and high ammonia. The first stage of recovery is an increase in the number of Tubificids and red Chironomids, followed shortly afterwards by increases in the numbers of algæ present though these are still low. A second definite stage is seen when the water-log-louse (*Asellus*) becomes abundant, the Tubificids and red Chironomids rare, the sewage fungus sparse and the algæ extremely abundant. The next stage is one in which the water-log-louse has decreased in numbers, though there are

often large quantities of snails, while the algal population is still very high. Finally, in the repurified state the stream is found to contain an abundant and varied fauna which includes caddis, ephemerids and at times shrimp (*Gammarus*) and an abundant and healthy growth of weeds and algæ.

In a general way the chemical stages of this repurification complex are the gradual increase in the amount of dissolved oxygen in the water, a continuous oxidation of ammonium salts to nitrites and nitrates and a decrease in what is called the Biochemical Oxygen Demand of the river water.

It has consequently often been concluded that an analysis of a river water or an effluent which shows the dissolved oxygen content and the free and saline ammonia is a satisfactory indication of the degree of pollution. While this may be so in straightforward cases of single organic pollutions, several investigations such as that cited above have demonstrated that such tests by themselves may be very misleading when a complicated system of domestic and industrial effluents has to be taken into account.[X13]

Evaluation of Laboratory Data

Analyses should be made of samples collected at all points of a treatment plant indicative of major treatment, and the number of tests made should be sufficient to obtain information on what happens to various constituents of sewage. In the chain of information, the sample is the first important link. Use of automatic samplers may obviate the weakness of this link, which is the human element.

Composite samples are of no value for bacteriological results or determination of chlorine demand. Unless samples are kept below 4°C. there will be a decrease in BOD. Flocculation of colloids occurs during long standing, affecting the suspended solids test. Suspended solid particles tend to settle in the sample bottle, and in removing test portions it is difficult to get one of average composition; a method of eliminating which is to mix the sample with an electric stirrer while siphoning off the test portion. In the case of withdrawing a portion of sludge from a sample bottle, shaking and then pouring will not give as true a sample as shaking followed by use of a glass thief sampler.[G27]

Reclaimed Sewage To Replace Ground Water

Practically all of the south coastal basin of California needs more water for its municipal supplies and the only alternative to importation of water from the Colorado river is to recharge the ground water supply with purified sewage from the city and county of Los Angeles. It is estimated that in 1947 about 280,000 acre-feet of such sewage will be discharged into the ocean. It is planned to treat and sterilize a part of this sewage and force it underground through wells; then recover it as ground water through wells located at least 1,000 ft. from these feeder wells. It is planned to replenish the ground water with 80,000 acre-feet per year through 110 wells. The cost of the plant, including activated sludge treatment, would be only 1/3 that of importing Colorado river water.[L12]

Hog Feeding at Los Angeles, Calif.

Los Angeles food waste has been fed to hogs continuously for 25 years by the Fontana Farms Co., the tonnage of garbage increasing from 118,257 in 1923 to 152,228 in 1945. During that time the garbage has so decreased in food value that, while in 1921 there was a gain of 68.9 lb. of pork per ton of garbage fed, the gain now is only 24.5 lb. (This is exclusive of the gain due to grain feeding, which is known precisely.) This is attributed largely to the more general use of home refrigerators. About 1/3 of the garbage dumped on the feeding floors is not eaten and is removed, together with the hog manure, dried to about 30% moisture content by spreading on land, and sold at $7 per ton for fertilizer. Bones removed from the waste now bring $24 a ton. Great care is taken of the health of the hogs; the company has been using about 2,500,000 cc of vaccine a year.[E16]

Cloths for Vacuum Filters

An analysis of reports from a considerable number of operators of vacuum filters showed use of a number of materials for filter cloths. These included flannel, unbleached muslin cloth, Victor filter cloth, 6 oz., 8 oz., 10 oz. and 12 oz. Canton flannel, 100% wool cloth, heavy duty cotton duck, lightweight cotton duck, "Vinyon" (a plastic fabric) chain twill weave.

The lives of filter cloths were reported varying from 30-45 hr. to 700-800 hr.; the range in one plant being from 30-45 hr. for cheap, thin cotton to 300 hr. for a better cloth. Most plants clean their cloths at intervals. One washes thoroughly after each 24 hr. of service. Several clean with high-pressure sprays after each run. Others apply 16 to 30% dilutions of muriatic acid to prevent blinding, with more or less favorable results.[H57]

Toronto's New Sewage Treatment Plant

The sewage of Toronto, Ontario, is now treated in an overloaded primary treatment plant whose effluent enters Lake Ontario midway between the intakes of the city's two water systems. A new treatment plant is under construction designed to treat 101 mgd (U.S. gallons) of dry-weather flow and 252 mgd of storm flow. Treatment will consist of grit removal, primary sedimentation, digestion, elutriation, mechanical dewatering and incineration of sludge, chlorination, aeration (activated sludge), and final clarification. The final effluent after this treatment is expected to have between 14 and 22 ppm of suspended solids and BOD. Only primary treatment units are yet under contract, expected to reduce suspended solids to 130 ppm or less and BOD to 175 ppm or less.[E15]

Treating New York's Sewage

Modern plants for treating New York City's sewage were inaugurated by the construction of the Coney Island plant, which began full operation in 1935 and Ward's Island project, which began operation in 1937. The Tallmans Island plant was placed in operation in 1939, complete treatment at Bowery Bay and City Island in 1942, Jamaica in 1943, and partial treatment at the 26th Ward plant in 1944. In addition to these seven, the city operates six old plants, treating a total of 410 mgd. The program for city-wide treatment, estimated in 1939 to cost $107,000,000, includes 5 new plants and extensions of 9 existing ones, giving a total capacity of 1,453 mgd.

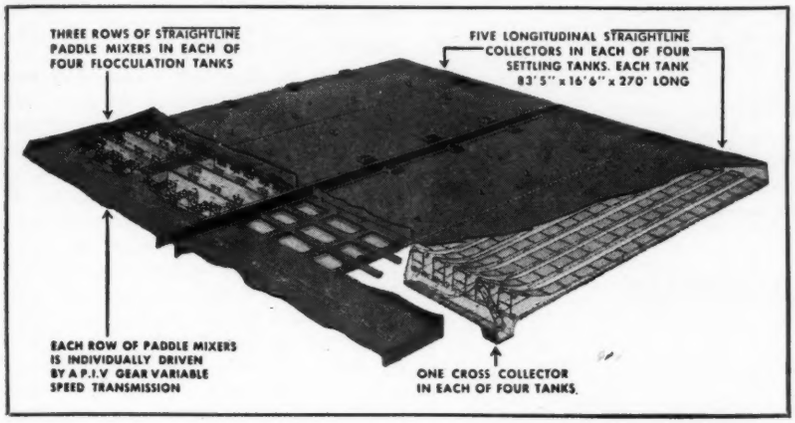
Four types of treatment are used in the new plants—activated sludge, step aeration, modified aeration, and seasonal chemical. Sludge will be digested and digestor gases utilized for power and heat, and the digested sludge will be disposed at sea.[X15]

Financing Sewer Revenues

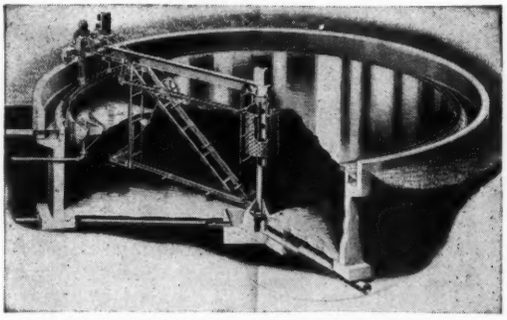
Provisions of ordinances prepared to permit Miami and Daytona Beach, Fla., to charge for sewerage service on the basis of water consumption were approved by the Florida Supreme Court. The principles embodied in the ordinances were as follows: 1—A sewer service charge is not a tax or a special assessment; it is a charge for services rendered and is identical with the water rates. 2—A water works cannot exist without some method of sewage disposal, and a sewerage system is useless without a water works. Therefore, the two are indissolubly combined in one municipal service. 3—The acceptance of the water rate based on the volume of water used as a fair method of financing water works improvements is in itself evidence that a sewer rate based mainly on the volume of water used is also fair. 4—A city has the right and duty to use all reasonable means to protect the public health, and the requirement that all inhabitants must connect to the sewerage system falls within the scope of this duty.[J20]

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 63-65*

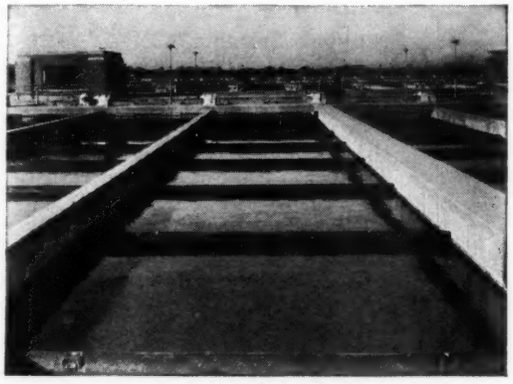
LINK-BELT Equipment *in* Water Works and Sewage Treatment



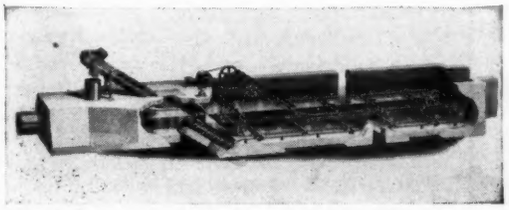
Link-Belt Straightline collectors and paddle mixers are used exclusively in the settling and flocculation tanks of the Lake Erie Water Project, City of Toledo Filter Plant. Each of the four tanks, which are 85' 5" wide by 16' 6" deep by 270' long, employs five longitudinal collectors and one cross collector — a total of 24 collectors being used. Each collector has an individual motor and drive. They are completely covered, as illustrated in the photograph to the left.



Circuline Sludge Collectors for the positive removal of sludge from round tanks. Send for Book 1982.



Straightline Sludge Collectors for the positive removal of sludge from rectangular tanks. Send for Book 1742.



Straightline Grit Collector and Washer. Effectively collects, washes and removes settled grit and separates it from putrescible organic matter. Send for Folder 1942.

CONSULTING engineers, public officials and operators of sewage treatment and water purification plants, have long known that Link-Belt screens, sludge collectors, mixing, aeration, conveying and driving machinery, are durable, dependable and economical. All Link-Belt equipment is engineered and manufactured in our own plants. It is built to last and to operate at maximum efficiency. Send for catalogs.

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Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8.
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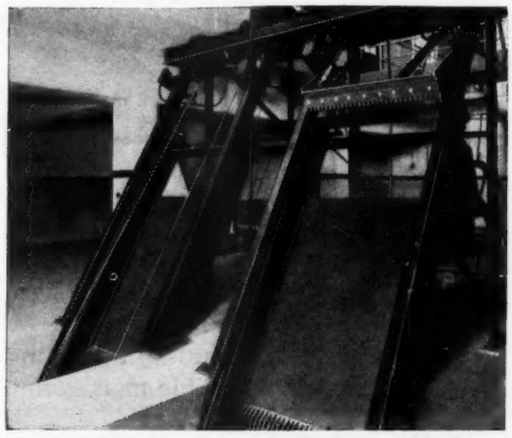

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When you need special information—consult the classified READERS' SERVICE DEPT., *pages 63-65*

Treatment Practice In Great Britain

In Britain, chlorination of sewage effluents "is often looked upon as camouflage, or passing the buck to downstream districts." The author prefers treatment that produces a permanently satisfactory effluent and one that permits a stream replete with animal and vegetable life.

The present policy is all toward getting sludge onto the land, as a liquid or a solid. Use of digester gas is growing. Two-stage digestion and thickening before digestion are on the increase. Fine screening is obsolete. Sedimentation detention periods of 6 to 8 hr. of dry-weather flow are usual; but British plants must receive storm water equivalent to 3 times dry-weather flow. For activated sludge plants the diffused air system is preferred to mechanical aeration. Recent developments in trickling filters have been concerned mainly with double filtration, recirculation, enclosed aerated filters and cyclo-nitrifying filters. In enclosed aerated filters the filters are completely covered and gentle currents of air are driven downward through the filter. English experiments show that the process can treat tank effluents at three times the rate of ordinary open filters; eliminates gases and flies, which must pass downward through the bed, the gases being oxidized and the flies drowned. In the cyclo-nitrifying filter, the effluent of activated sludge is passed through high-rate filters, and the highly-nitrified effluent of these is returned to the activated sludge plant; which produced great improvement in quality of effluent and condition of sludge.[M25]

Heating Digesting Sludge

Sludge in digestion tanks is heated either by heat introduced directly into the digester, or by heating the sludge outside the tank. Inside heating is performed by horizontal hot water coils; by vertical hot water pipes suspended in the center of a small tank, or several distributed uniformly about larger tanks; by submerged gas burners; or by steam or hot water introduced directly into the sludge. Outside heating of sludge is effected by applying steam directly to the daily additions of sludge in sludge-concentration tanks; or by hot water heat exchangers. There are several forms of such exchangers. In one, sludge drawn from the upper 2/3 of the digester is circulated through pipes surrounded by hot water, raw sludge being included in this when it is added. In another type there are two concentric pipes, raw sludge being pumped through the inner, while hot water is circulated in the opposite direction through the annular space. External heaters can transfer to the sludge more heat per sq. ft. of exchanger surface than can internal pipes; are more accessible for cleaning and repairing; and avoid the temperature drops in a digester caused by adding unheated raw sludge to it.[M27]

Financing Sewerage Systems

The common methods by which a municipality may raise funds for the construction of sewerage facilities are:

1. General obligation bonds.
2. Special assessments or special assessment bonds.
3. Current revenue from existing sources or from reserves.
4. Revenue bonds or revenue certificates.
5. Creation of a special organization or independent corporation, such as a municipal authority, a metropolitan district, a sanitation commission or a sanitary district.
6. Temporary loans.
7. By a combination of two or more of the above methods.
8. Privately owned sewer company.

General obligation bonds usually bear a lower interest rate than revenue bonds. Assessments may be either benefits or front foot; the latter is generally preferred. No. 3 is seldom used for major construction operations. For No. 4, the sewer charge should be sufficient to cover all annual expenses, sinking fund and a 10% margin of safety. Organizations referred to in 5 are substantially the

same as corporations and can borrow money and issue bonds secured by sewer rentals.[M31]

Sedimentation Of Filter Effluents

Many sewage effluents, satisfactory in other respects, are condemned because of their excessive content of suspended solids. In some cases plant extension, effluent filters and other expenses might be avoided if really efficient final sedimentation were obtained. The effluents of trickling filters often contain unloaded solids in a fine state of division which do not settle readily in humus tanks. It is possible that the newer types of filters, by flushing solids from the beds more rapidly, may improve sedimentation by preventing the disintegration of the solids into fine particles; or, on the other hand, by washing them out before having time to form large flocs, the reverse may be true. There is need for careful study of the whole question of final sedimentation.[D55]

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New Water Supply for Guayaquil, Ecuador

The City of Guayaquil, Ecuador, has contracted with three United States firms for investigations, design, construction and initial supervision of operation for a new waterworks system to serve the City.

Buck, Seifert and Jost, Consulting Engineers of New York City, are making a study of the water supply requirements and proposed sources of supply and, after completion of their report, will prepare construction plans and specifications and supervise construction. The Frederick Snare Corporation of New York City will perform the construction work. After completion, operation of the waterworks system will be supervised for one (1) year by the Pitometer Company of New York City.

The new system is expected to consist of intake works on the Daule River about thirty kilometers north of Guayaquil and an aqueduct leading to the city, together with large sedimentation basins to partially clarify the silt-laden river water, diesel-electric pumping station, filtration plant, distribution reservoirs and transmission and distribution system improvements. The cost of the project will be about $4,000,000. It is to be financed by the Export-Import Bank.

The present water supply of Guayaquil, a city of about 170,000, is obtained from mountain streams in the foothills of the Andes, about 90 kilometers east of the City. This supply, with a present yield of about 5.8 million gallons per day, was almost entirely rebuilt somewhat over twenty years ago by the J. G. White Construction Company, but proved inadequate to meet the rapid growth in requirements within a few years after completion. The hours of water service during the day have been restricted for many years and were still further curtailed early this year by a break in a supply main under the Guaynos River. The break was repaired recently by Frederick Snare Corporation and an additional subaqueous line will be constructed soon.

Winter Heating Equipment for Construction

Old man Winter is just around the corner, waiting to blow his icy breath on the construction jobs now in progress or to be started in the near future. Littleford Bros. has reminded us of some of the various items of cold-weather heating equipment needed to keep both men and materials warm and workable.

Salamanders — The many uses on winter construction jobs for either the oil burning, or wood or coke fired salamanders include: Curing of concrete in frigid weather; preventing the freezing of aggregate; drying new plaster or masonry; drying forms; melting ice and snow; thawing frozen material cars; maintaining safe temperatures in warehouses; and protecting perishables. Salamanders can also be used for warming stations for workmen on out-of-door jobs. The "accordion" type oil burning salamander has fins which are designed to give greater distribution of heat and more radiation than standard types. The burner unit can be detached for thawing and similar jobs. Coke and wood burning salamanders consist of a single piece metal shell with cast iron grate and ash pan; hoods and covers for these salamanders can be furnished.

Water Heaters are available which are capable of supplying as much as 800 gallons of hot water every hour while raising the temperature of the water 100 degrees. If the temperature rise is less, the output can be increased still more.

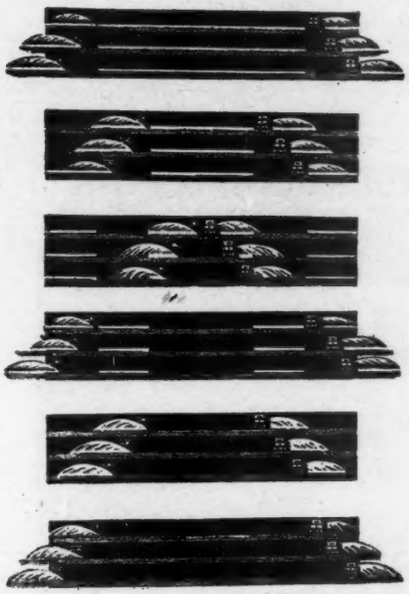
Concrete Heater-Equipped Mixers can produce concrete at the correct temperature to start curing properly in cold weather. The ultimate strength of winter poured concrete depends largely on how temperature is controlled while it sets up. A torch type burner is best for use on mixers of 3½ to 21-foot capacity. For larger mixers and pavers a low pressure type burner is recommended.

The Highway and Airport Digest

Snow Control On Airports

Based on tests conducted at the Clintonville, Wisc., municipal airport by F. W. D. Auto Co., a snow plow of special design and methods of using it to the best advantage were developed. The plow is a reversible hydraulic with controls inside the cab, and has a moldboard of such shape that the snow travels up and across its face and is discharged at an angle above the horizontal, and is set at a sharper cutting angle than is customary for highway plows. Also it has long shoes like skiis which leave ½" to 1" of snow on the surface.

In operation, as much snow as possible was moved in a down-wind direction. If there was no wind or the wind was parallel to the runway, an equal amount of snow was moved in each direction. When the snowfall was heavy, three plows working in echelon cleared first the outer 30 or 40 ft., then moved the next 30 or 40 ft. onto this cleared space, then re-transferred it off the strip in successive operations as shown in the illustration. Later the snow outside the runway could be plowed into windrows which served as snow traps to catch drifting snow. A width of 100 ft. each side of the runway was cleared to serve as temporary storage space, to be cleared after the storm. To guide the snow plows at night, the boundary lines of these areas were marked by 5 ft. staffs carrying flags and 5" button-type amber reflectors, spaced about 1,000 ft. apart.[J35]



Courtesy The American City

Typical operation in snow removal from an airport.

Reducing Contract Costs in Missouri

By reducing construction refinements as much as possible without sacrificing the quality of the work, and eliminating as much as possible of the uncertainty in bidding, the Missouri State Highway Dept. has obtained lower bids on its highway work. Earth compaction requirement was reduced from 95 to 90% of the department's standard. Lifts in embankment have been increased from 6" to 12" on primary roads and from 12" to 36" on farm-to-market roads, where the material is mainly rock. The amount of hand finishing required on slopes has been reduced. Use of tar paper beneath concrete pavement has been abandoned. On farm-to-market roads, tolerances in grading of 2 ft. in alignment and 6" in grade are allowed; subgrade scarifying has been reduced from 12" to 6"; right-of-way clearing is now confined to roadway limits instead of the entire right-of-way; pipe has been substituted for reinforced concrete boxes for small culverts. In concrete bridge construction, rubbing the surface has been limited to curbs, handrails and outside surfaces of girders.

In excavating stony loam containing heavy red clay, a contractor averaged 4,000 to 6,000 cu. yd. per 10-hr day or an average haul of 900 ft., using one 8 cu. yd. and one 14 cu. yd. carrying scraper pulled by large crawler-type tractors; two 10 cu. yd. carrying scrapers, each pulled by a pneumatic-tired 4-wheel tractor capable of operating up to 20 mph; two bulldozers; three tractors operating as pushers in loading the scrapers; one rooter with tractor; two sheepsfoot rollers with light tractors; and two motor graders.[E40]

Air Entraining Admixtures Approved

Public Roads Administration has approved the use of three admixtures for obtaining air entrainment in concrete—Vinsol resin, Darex AEA, and Pozzolith. Vinsol resin is a fraction of natural pine wood resin insoluble in light petroleum fraction and in water. It is furnished in flake or pulverized form and a solution is prepared by neutralization with a solution of caustic soda. Darex AEA is substantially a triethanolamine salt of a sulfonated hydrocarbon, furnished in solution ready for use, in containers varying from 5-gal. drums to tank cars; one fluid ounce per sack of cement is recommended. Pozzolith is made in two forms—an insoluble dry powder and a solution. An insoluble form is composed of calcium lignosulfonic acid, calcium chloride and a small amount of pozzuolanic material; and a soluble form in which the last named ingredient is omitted. It is furnished as a fine, dry powder in 50 lb. bags. The PRA says that the difficulty of plant-mixing accurately such small amounts of admixtures—2 to 5%—will be met by use of automatic dispensers which will be available in the very near future.[E41]

Laying Asphaltic Concrete in Kentucky

One of the most popular pavements for Kentucky highways is a 6" surface of asphaltic concrete on 6" of waterbound macadam. In constructing this, if the soil has low bearing value a 3" insulation course of traffic-bound macadam is laid and, after traffic has passed over it for a few days, it is reshaped to crown and ½" to 1" of No. 10 screenings are added, wetted and rolled until thoroughly bonded. Then a 3" course of waterbound macadam is laid using stone from 2" down, thoroughly rolled, covered with screenings copiously watered and rolled. Three days later a second similar 3" course is constructed. When this has become thoroughly dry it is given a prime coat of RT3, followed by two courses of hot-mix bituminous pavement, a lower course 3½" thick and a 2½" surface course. Total cost about $35,000 a mile.[E42]

Soil-Cement Base in California

The latest method employed on California highways for using cement-treated soil as base is illustrated by Rosemead Boulevard, where a 4" asphaltic concrete surface was placed on an 8" base, made in two 4" courses. The bottom course was native soil into which 5 1/3% of cement was mixed. The mixture was graded to shape, compacted with a 12-ton tandem roller and a 6-ton pneumatic tired roller, and an emulsion curing seal was applied. The second 4" was imported soil with which 6½% of cement was plant-mixed, spread and rolled in the same way as the bottom course. The compressive strength was unusually high.[W19]

Wire Fencing Prevents Rock Falls

At one point on the Columbia River highway in Oregon a rock cut was made for a length of 200 ft. with a face 150 ft. high on a 1:6 slope. To meet the danger of small rocks falling onto the road, the entire face is enveloped with strips of wire fencing suspended from the top, adjacent strips overlapping 2" and wired together. During 7 yrs. of use this has proved 100% successful.[N74]

Subgrade Troubles On a California Road

Resurfacing a 14-mile section of State Route 73, California, included a 2-mile strip across Mud Lake consisting of a 5-ft. fill. This had given considerable trouble by developing longitudinal cracks and fissures extending the depth of the fill and, in many instances, several hundred feet in length. This is caused by drying up of the lake bottom during the summer months. Several attempts were made to correct this by raising the grade of the fill, with no permanent success. On the project just completed a cushion course 0.33 foot thick of imported gravel base has been placed on top of the existing pavement for the purpose of dissipating any stresses that may originate in the future, thus preventing them from damaging the newly laid plant-mixed surfacing.

At another point, on a summit, imported borrow 12" thick had been placed on an old oiled surface and a new pavement laid on it. When resurfacing this top pavement it was found that the imported subgrade was saturated with water although there was no visible seepage of water anywhere, the summer was one of the hottest on record, and the material beneath the old oiled-earth surface was relatively dry.[W16]

Wright Field Heavy Duty Runway

Last week we described "the heaviest pavement yet installed by the Army," 8,000 ft. long by 200 ft. wide with a concrete pavement 18" thick, located in California. A few weeks ago work was begun at Wright Field, near Dayton, on a 10,000 ft. by 300 ft. runway of 21" concrete, and a 150 ft. wide taxiway 25" thick. This will require 350,000 cu. yd. of concrete. The subsoil is composed of strata and pockets of clay, silt and gravelly materials, which are to be mixed and compacted with a 450 psi sheepsfoot roller followed by a lighter one, to obtain a 95% modified AASHO density. There will be no expansion joints. Slabs will be placed in 25 ft. strips, with dummy joints every 20 to 25 ft. Special steel forms are being made with 21" by 25" sides, for use for either runway or taxiway. Concrete with 4.5% air entrainment will be used. The reinforcement will be No. 5 gauge mesh, 3" centers. Concrete with 3" max. aggregate will be placed and struck off 4" below the pavement surface, the reinforcement placed, and the pavement finished to grade with concrete with 1½" max. aggregate. It is possible that a gang vibrator outfit will be used, consisting of ordinary internal vibrator units mounted on a bridge.[N71]

New Goals for Highway Lighting

Basic standards recommended for the National System of Interstate Highways establish for the first time a fundamental guide for highway illumination. The Illuminating Engineering Society has just revised its "recommended practice" to conform to recent requirements and technical possibilities. The Interstate Highway standards emphasize the need for transitional lighting between lighted and unlighted or dimly lighted sections of highways. The IES "recommended practice" attempts to appraise pedestrian traffic volume and introduce it as a factor in determining illumination requirements.

Incandescent filament lamps will be used for most highway lighting, although mercury vapor lamps are being used for relatively high-level lighting. Fluorescent lamps are not yet practicable for highway lighting.

The Committee on Highway Lighting, Highway Research Board, estimates the cost of lighting per mile of 4-line freeway, at 0.8 average footcandle, to be $10,600 with filament lamps, $10,800 with mercury and $16,100

with sodium, all with underground cable; or about $3,100 to $4,500 a mile less if with overhead wires.[E37]

Undersealing with Asphalt in Virginia

Virginia's experience closely parallels that of Texas. (See "Undersealing with Asphalt in Texas" in November's Digest). The state used 10,000 gal. of 30 to 40 penetration asphalt for that purpose in 1945 and 60,000 in 1946, and will probably use more in 1947. It is placed at a temperature of 375°. One lane is worked at a time, leaving the other free for traffic. Usually one 1½" hole is drilled in each lane, 15" to 18" from the joint in the direction of travel. Before pumping of the asphalt begins, the surrounding pavement is painted with a solution of 2 lb. of lime in 8 gal. of water, to prevent spilled asphalt from sticking to the pavement. If the difference in elevation of two slabs at a joint exceeds 1½", instead of asphalt they use a slurry of 48.2% clay, 16.1% lime, 6.0% Portland cement, 9.6% RC-1 bituminous material and 20.1% water. The average amount of asphalt used per hole is 15 gal. and the average cost for material and labor was $2.31 in 1944.[E38]

Retreatment In South Carolina

This year for the first time South Carolina has contracted for the retreatment of its roads, the process employed being the same used by the state for the past 10 years. It has been found necessary to retreat a road on an average of every 6 to 8 years. Two grades of aggregate are used. The coarse aggregate must all pass a ½" screen, 50% a No. 4 screen, and 0-6% a No. 16. The fine aggregate must all pass a ⅜" screen, 86% a No. 16, and 0-5% a No. 100. The asphalt used is a high grade RC-1, 2 or 3 cut-back. Prior to placing any aggregate, a tack coat is applied at the rate of 0.10 to 0.15 gal. per sq. yd. Immediately 15 to 78 lb. per sq. yd. of coarse aggregate is spread uniformly and covered with 50 to 40 lb. of fine aggregate. The aggregates then are mixed and leveled and asphalt applied at about 70 to 80 gal. per sq. yd. This is thoroughly mixed, using two standard mixing and leveling machines joined side by side, drawn by a heavy tractor and carrying a strike-off board having the proper width and crown. It is then rolled.[N70]

Soil-Cement Base in California

During 1946 about 15 miles of concrete pavement on a soil cement base was laid on California's Coastal Highway. The cement concrete surface was 8" thick and the soil-cement base 6" thick in some stretches and 4" in others. The concrete was laid in 11 or 12 ft. lanes, adjacent lanes being tied together with ⅝" x 30" bolts spaced 30" apart. There were no expansion joints. Transverse joints ¼" x 1¼" were spaced 15 ft. apart. In one section where a

high percentage of the existing soil passed No. 270 sieve, blending 50% sand with the soil reduced the swell from 0.7 to 0.2% and increased the compressive strength from 295 psi to 640 psi.[N75]

Bibliography of Highway and Airport Literature

D *The Surveyor*
October 4

25. Reinforced Concrete Road Culvert. By W. Scott Wilson. Pp. 759-761.
26. Tar Surface Dressings. By W. E. Cone. Pp. 765-766.
27. Roads and Footpaths. P. 772.

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28. Snow Clearing and Gritting. By Thomas Young. Pp. 801-803.
29. Road Maintenance in Hampshire. Pp. 805-806.

E *Engineering News-Record*
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37. New Goals Set for Highway Lighting. By H. E. Mahan. Pp. 56-59.
38. Virginia Expands Use of Asphalt to End Pumping at Joints in Rigid Pavements. Pp. 60-62.

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39. Phoenix Plans a New Airport. By John Girand. Pp. 104-105.
40. Missouri State Highway Construction. Pp. 106-111.
41. Air Entraining Admixtures Included in PRA Specifications. Pp. 114-116.
42. Kentucky Attains Record Road Program Despite Unfavorable Conditions. Pp. 117-119.

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23. Doubled Asphalt Layer Improves Fort Dodge Streets. By C. B. Pilcher. Pp. 86-87.
24. Financing Express Highways in Metropolitan Areas. By Donald M. Baker. Pp. 93-94.

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25. Gear Snow Work to Airport Requirements. By J. R. Shannon. Pp. 98-99, 108.
26. Score Your Asphalt Plant. By L. D. Long. Pp. 109-110, 137.

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10. Owner-Operator Cooperation Essential to Maximum Use of Airport Facilities. By E. H. Sittner. Pp. 478-480.

N *Roads and Streets*
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70. South Carolina's Retreatment Methods. By H. K. Glidden. Pp. 69-71, 87.
71. Massive New Runway at Wright Field. Pp. 74-75, 108.
72. CAA Announces $30,822,750 for States. Pp. 76-78.
73. Virginia Looks Ahead. By R. P. Ellison. Pp. 79-80.
74. Hanging Fence Wire Prevents Rock Falls. P. 85.
75. California Concrete Pavement With Soil-Cement Base. Pp. 90-96.
76. Safety in Road Building. By L. W. Hagerup. Pp. 100, 102.

O *Roads and Bridges*
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52. Maintenance of Airfields and Airfield Runways. By E. C. Todd and O. H. Hays. Pp. 64-65, 118.
53. Waterproofing Bituminous Mixes. By Herbert P. Pearson. Pp. 68-69, 126.
54. Road Safety Engineering Facts. By Gibb Gilchrist. Pp. 73-76, 127.

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44. A Mathematical Rating for Priority of Road Construction. By H. S. Wiley. Pp. 21-24.
45. Liability Insurance as Related to California Highway Contracts. By Kenneth A. Keyes. P. 28.
46. Methods of Stabilizing Embankments at Terminal Island. P. 37.
47. Highway Maintenance Operations in Wayne Co., Mich. P. 37.
48. Soil Characteristics for Mudjacking Studied by New Jersey. By F. D. Woodruff. P. 38.
49. Legal Decisions Relating to Highways. P. 43.

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41. Texas Trains Veteran Apprentices. By D. C. Greer. Pp. 21-23.
42. How Well Do We Manage Words? Pp. 25-26, 40.
43. Rural People Aid System Planning. By E. L. Worthington. Pp. 31-32.

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14. Reduction of Fire Hazards Along California State Highways. By E. S. Whitaker and H. N. Bosworth. Pp. 6-7.
15. Results Obtained and Experiments Made in Asphalt Subsealing. By H. L. Hooper and W. R. Sovering. Pp. 8-12.
16. Fourteen Miles of Three Flags Highway Has Been Resurfaced. By Louis Aramayo. Pp. 13-14, 32.
17. North Sacramento Freeway Project Construction Well Advanced. By Arthur L. Elliott. Pp. 15-18, 31.
18. Limited Access Postwar Project in District X Nearing Completion. By Marc C. Fosgate. Pp. 19-20.
19. Rosemead Boulevard Job Completed. Pp. 26-28.

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18. The Location of Trunk Roads in Urban Areas. Pp. 2552-2553.

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19. The Location of Trunk Roads in Urban Areas. Pp. 2603-2607.

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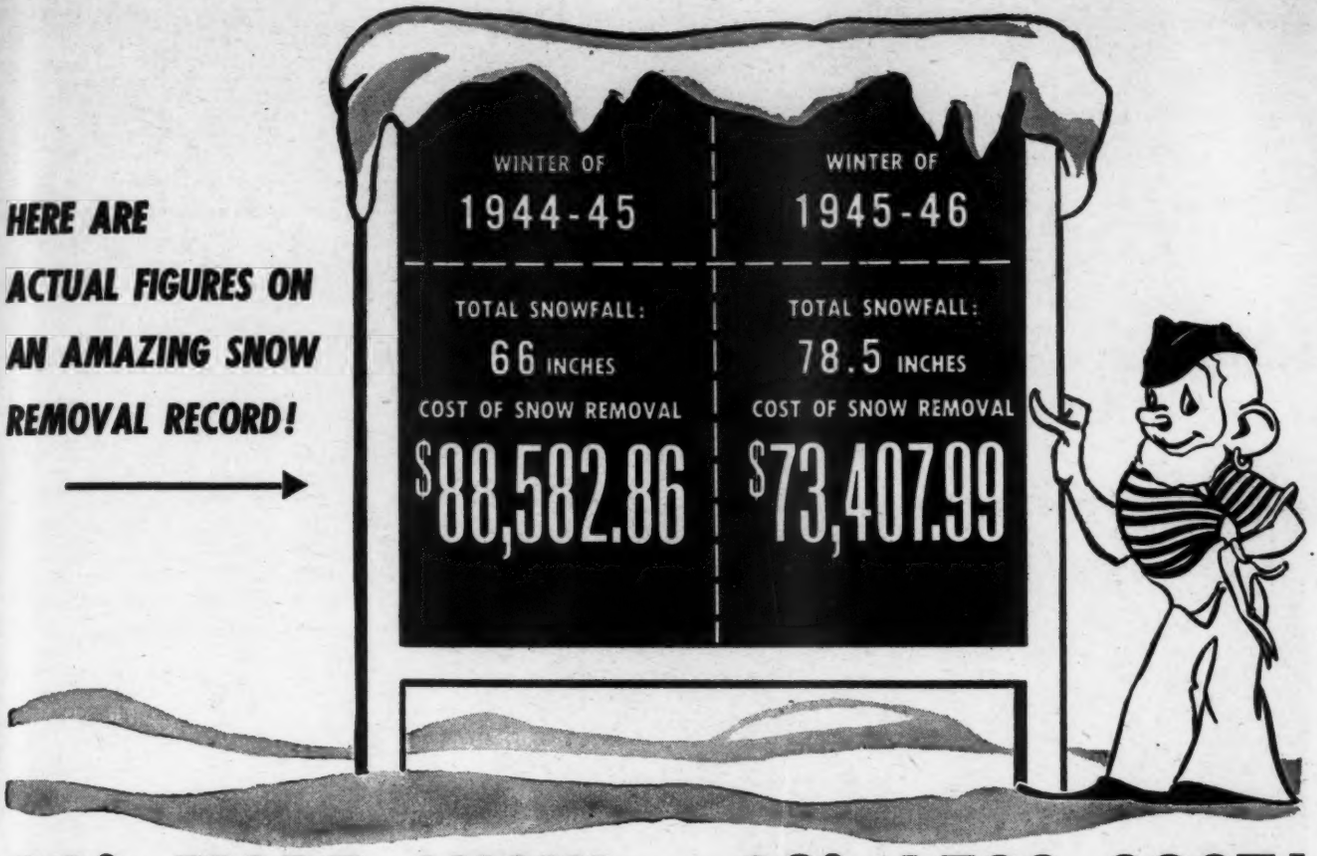

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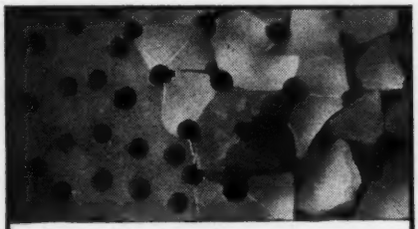

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When you need special information—consult the classified READERS' SERVICE DEPT., pages 63-65

Preventing Electrolytic Damage to Pipe Lines

The development of a Stray Current Control System, to prevent the damaging effects caused by electrolytic action on underground pipe installations, including gas, oil and water lines, conduits, telephone cables and similar items, is announced by the Cook Research Laboratories, Chicago. Electrolysis occurs when stray currents in pipe lines seek to escape through the surrounding soil, and in so doing touch off a reaction in which metal from the pipe is removed. This action is not to be confused with rusting, where weather and soil conditions play a far greater part in causing the corrosion. Electrolysis is especially severe in areas where there is an overhead trolley wire or third rail, and the car tracks are utilized as a return circuit to the power house.

The Stray Current Control System is a current and voltage-sensitive device, operating jointly on a high current contactor. When stray current tends to leave the pipe, the contactor will close; thereby connecting the pipe and rail with a solid metallic bond on which the current may travel harmlessly rather than by damaging electrolytic action through the soil. Conversely, the contactor will open instantaneously when the current tends to flow in the opposite direction, that is, from rail to pipe. In this manner the contactor will prevent the system from becoming a back-path for more stray current, which if permitted to flow uncontrolled would result in further electrolysis of the pipe.

Costs of Street Name Signs

A vertical-type street sign with the letters of the street name placed one below the other has been adopted by Denver, Colo. The sign is composed of a three-sided sheet metal tube which is slipped over a concrete post and secured by two bolts. Complete cost of labor, material, and installation is $4.73 per sign. Dallas, Texas, has street name signs which consist of metal markers mounted on concrete posts. The cost per sign and post, exclusive of cost of installation, is $9.35. Signs of 12-gauge steel with black letters on white enameled background are being installed by Alameda, Calif. The signs, standards, fittings and labor costs total slightly less than $5 per sign.

Small City Builds Parking Garage

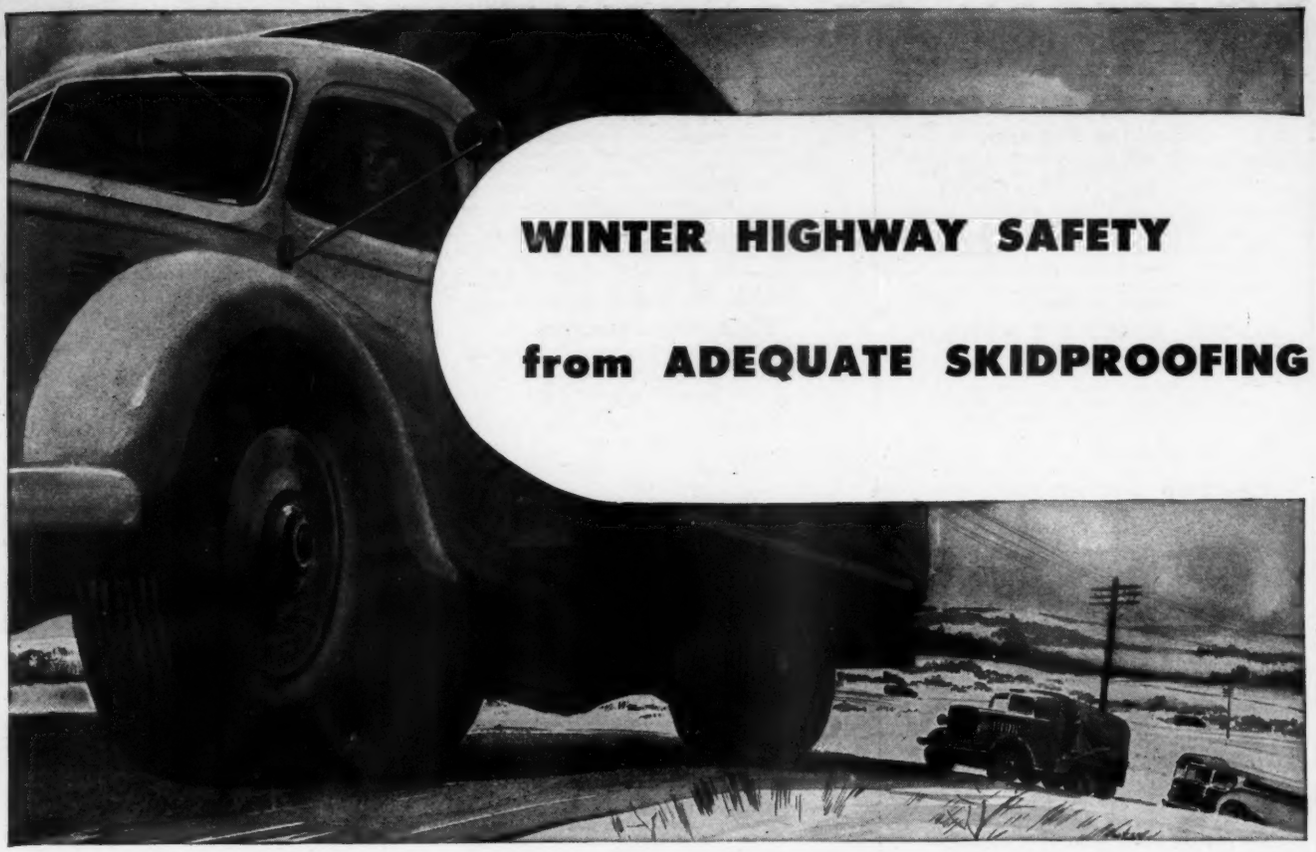
Bluefield, W. Va., has sold $450,000 in revenue bonds for the construction of an automobile parking garage. The city has narrow streets and a compact business district with no vacant lots for parking purposes. An effort to get private interests to erect a parking building failed, and the city acquired a tract of land in the business district at a cost of $114,000. The parking project will be an open-sided, four-floor building with a capacity of 800 cars. The city plans to lease space on the first floor to an oil company that will furnish gas, oil, greasing, and other services to patrons. The bond issue for the construction of the building will be 30-year serial bonds with an average interest rate of 2.6 per cent. Estimated annual income after operating costs amounts to nearly $48,000.—E. P. Mitchell is City Manager. —*Public Management.*

Black Top Road Maintenance and Construction. — This 30-page booklet describes and illustrates bituminous pressure distributors, supply tanks, steam heaters, spray tanks, emulsion sprayers, surface heaters, road brooms, transfer pumps, maintenance kettles, tool heaters, patch and repair rollers, water tanks, tool boxes, water heaters, salamanders, and many small tools. Well prepared and contains much information. Ask for catalog W, Littleford Bros., Inc., 452 East Pearl St., Cincinnati, O.

Manual of Design for Arc-Welded Steel Structures, 300 pages, illustrated, covers design, materials, inspection, estimating and engineering control of welding and related operations. $2. Air Reduction Sales Co., Dept. MD, 60 East 42nd St., N. Y.

Forms for reinforced concrete pipe, 8-inch to 108-inch diameter, are described in a folder issued by Flint & Walling Mfg. Co., Inc., Kendallville, Ind. Dimensions of pipe are given.

When you need special information—consult the classified **READERS' SERVICE DEPT.,** *pages 63-65*



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Letters to the Editor

Small Sewage Plants:

DEAR SIR:

In the October issue of PUBLIC WORKS you stated on The Editor's Page that little had been done by manufacturers along the lines of developing sewage disposal equipment for summer camps and rural schools. Apparently you overlooked the Yeomans equipment available for these types of installations. Our "Water-Wheel" distributor is designed for just such applications, and our many installations are giving satisfactory service.

YEOMANS BROS. CO.
J. M. Porter

Chicago, Ill.

(We really had in mind the individual homeowner or small groups of two or three homes. We are familiar with the "Water-Wheel" distributor and did not mean to appear to overlook it. This is made in sizes as small as 5 ft. diameter to handle 1100 gallons of settled sewage per day.—Ed.)

Highway Problems:

DEAR SIR:

I was very interested in your editorial "Some Highway Engineering Problems" appearing in your October PUBLIC WORKS. The specific comment is made ". . . we need more research in low cost road construction." Perhaps what we need is more widespread application of what it already known.

M. D. CATTON, *Manager*,
Soil-Cement Bureau,
Portland Cement Ass'n.

Chicago, Ill.

(The emphasis was intended to be on methods *of low cost road construction, and to continue the theme from the editorial in the July issue. Our present-day scarcity of labor stresses the need for research into the development of machines to build roads better, more cheaply and with less reliance on common labor.—Ed.)*

Small Septic Tanks:

DEAR SIR:

Since Spokane County, Wash., developed regulations for such installations, many hundred septic tanks of 500 gallons, minimum size have been installed. This . . . has brought forth many designs . . . and raises the question as to which design for a given rating is satisfactory. . . . The County . . . has neither facilities nor time to test each and every such product so the writer is endeavoring to obtain some fairly basic values on which to determine the quality of the design submitted. Have you any suggestions to offer on how . . . to make reasonable deductions in unusual designs, . . . proportions, flow of contents, sludge capacity, retention period, storage volume for solids, gas chamber volume, temperature values, etc. ? . . .

STEPHEN H. EXCELL,
Spokane County Health Dept.

Spokane, Wash.

(It is our opinion that proper subsurface disposal is much more important than tank capacity; and that reduction of required capacity to 300 gallons, the general commercial tank standard, would eliminate these "unusual" designs through an immediate cost reduction. Installation through licensed plumbers would greatly reduce Health Department burdens and insure generally better jobs. Metal tanks have an indefinitely long life and the 300-gal. tank, with proper disposal of the effluent, is as good for a one-family installation as a larger tank.)

Pay for Engineers:

Referring to our editorial statement recently on more pay for Engineers, quite a few of our readers have asked us what we are doing about it, and a few have pointed out that what many engineers need is "pay"—it isn't a matter of "more pay." A large city in Oklahoma, advised by the manager to enlarge the city engineering staff and increase its pay in order to handle a large sewer construction program, instead "farmed out" the work. The consulting engineers then hired many of the staff at more than the city would pay. A city in Texas is trying to design an expressway, but some of the drawing boards are empty because the city will not pay enough to get engineers. In a small city in Missouri, a key man stayed on during the war with his $50 depression cut on promise of a better deal. When it didn't come, he quit and started selling cookies; now he is manager of the bakery, and, so to speak, in the chips—certainly as compared to his previous engineering job. The largest city in Kansas now pays its city engineer less than it paid 20 years ago, and less than the foreman hired by the contractor to boss the sewer gang.

What are we doing? Not much, we fear, but a little. Each one of the jobs listed on page 66 of this issue has been a matter of bargaining between the editor and the would-be employer. No job is listed unless it is deemed to carry a fair salary for the work required. The ante on some of them has been raised as much as a thousand dollars in this way; on others much less; on some not at all.

Though our efforts may reach only a few we are going to keep on trying; whatever we can do, we will do; and we'll be glad to have suggestions and comment.

PUBLIC WORKS Equipment News

Air-Power Tractor Unit

A mobile construction unit which combines a tractor with an air compressor is built by the Le Roi Company, 1706 So. 68th St., Milwaukee 14. Called the 105 Tractair, the unit has a compressor furnishing 105 cu ft. of air per min. at 100 lb. per sq. in. pressure mounted on a 35-hp. wheel tractor; weight dry, is 3,400 lb. and wheel-base is 75 in. The unit runs on pneumatic tires. Standard equipment includes an electric starter, sealed-beam headlights, pressure lubrication for both engine and compressor, and rear-wheel guards. Auxiliary equipment, to be available shortly, will include rear or side power take-off, highway-airport

Le Roi Air-Power Tractor.

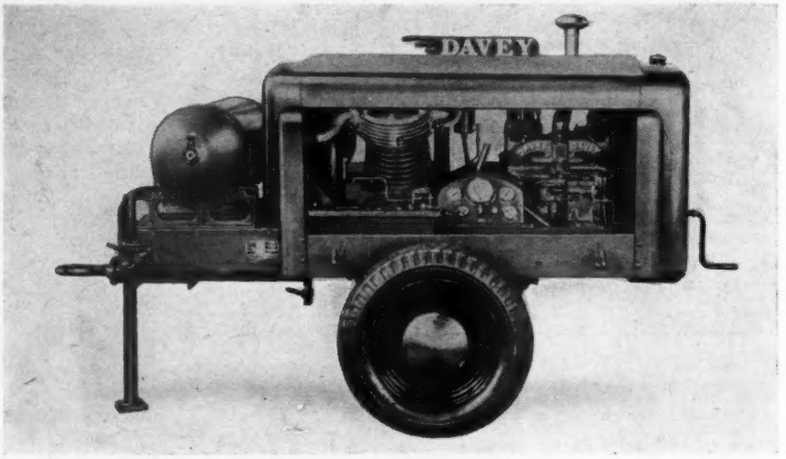
mower, rotary brush, snow plow, front-end crane, and similar accessories. *(Add to Chapter 1, Highway, Street and Airport Manual.)*

Huber Is First American Roller in Sweden

The first American road roller in Sweden is a 10-ton, 3-wheel Huber, sold through The Swedish Trading Co., Stockholm, to Svenska Entreprenad A. B., one of that country's largest road-building and constructing organizations.

Handy and Efficient Small Power Mower

This power mower will mow under fences, around trees, rocks and fence posts, in fence corners and in any other close quarters. It is especially adapted for cleaning up highway roadsides and mowing around culverts and guard rails, supplementing the work of larger machines and practically eliminating hand mowing. It is equipped with a 1½ hp engine, cuts 36 inches wide, is self-propelled and has a low center of gravity. Wheels are 20 ins. in diameter. Weight is 174 pounds. For fuller information and descriptive folder write James Cunningham, Son & Co., Rochester 8, N. Y. *(Add to Chap. 6, Highway, Street and Airport Manual.)*



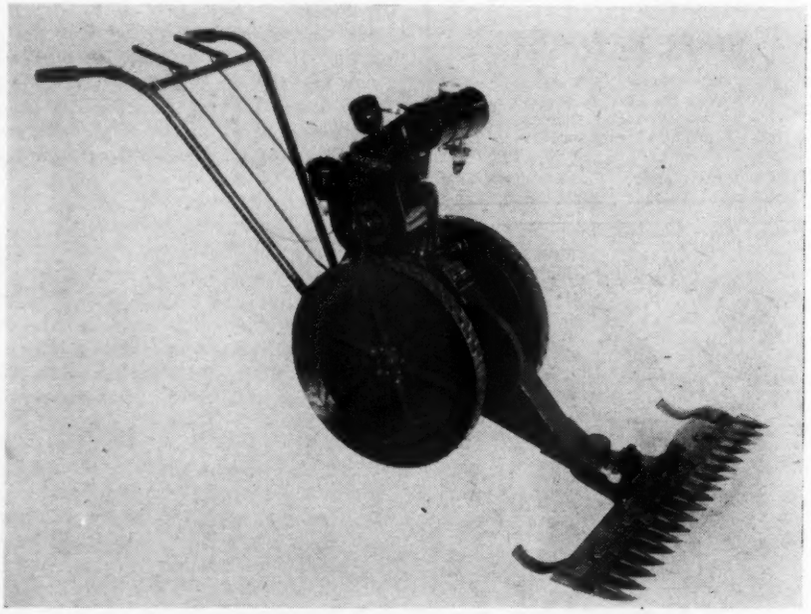
Davey 60-ft. portable compressor.

New Davey 60-Ft. Portable Compressor

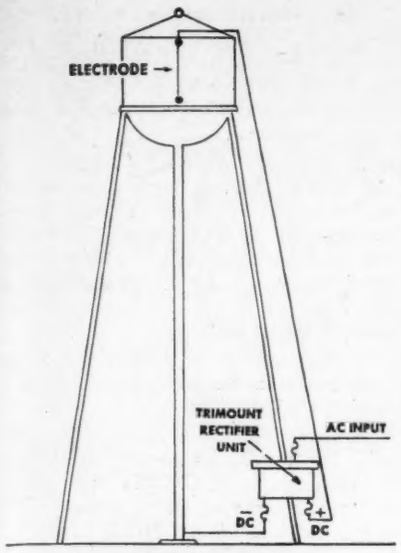
The Davey Compressor Co., Kent, Ohio, has announced a new 60-ft. portable compressor. This new unit is available in standard skid and 2-wheel penumatic-tired trailer mounting styles; also with a heavy duty power take-off as an "Auto-Air" compressor for truck mounting. The compressor produces 60 c.f.m. at 100 lbs. pressure and is designed for heavy duty service. It has one low pressure cylinder with 5¾" bore and 4½" stroke. The high pressure cylinder has 3⅝" bore. Operating speed is 1225 r.p.m. Weight of the 2-wheel model is 2100 lbs. Over-all dimensions are: length, 88"; width, 62" (tire track line, 52½"); height, 51½". The compressor is powered by a Hercules IXB Engine.

Cathodic Rectifier Prevents Rust in Tanks and Pumps

The Trimount Instrument Co., 37 W. Van Buren St., Chicago 5, Illinois, announces a new cathodic rectifier unit to provide rust and corrosion protection for steel water tanks and deep well pumps. This unit stops rust and corrosion by eliminating the electrolytic action on the metal being protected. Ordinarily, a steel tank or pump acts as a galvanic battery, the submerged part forming the



The Cunningham Mower reduces hand work.



ELEVATED WATER TANK

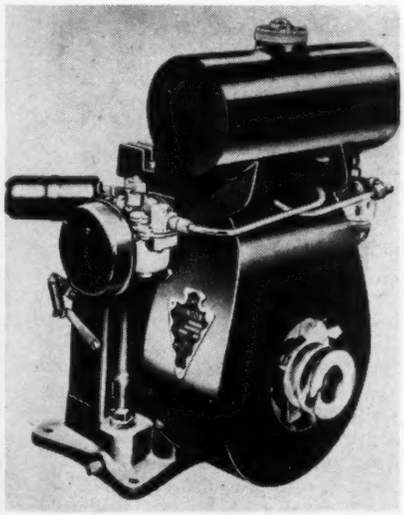
Trimount cathodic rectifier.

anode, which is subject to rapid rusting, pitting, or corrosion. With a cathodic rectifier unit the flow of current in the tank or pump is reversed by introducing a cathode which is charged by the rectifier. The metal of the tank or pump thereby becomes the cathode and is not subject to corrosion or rust.

The unit is contained in a weatherproof steel cabinet and has a D. C. output capacity of 2-5 amps. at 31-50 volts (100 to 150 D. C. watts)—sufficient to protect submerged areas up to 10,000 sq. ft. Preferred A. C. input is 110-3-60, but the unit can be equipped to take other A. C. characteristics. Step controls up to 50 D. A. with moving coil type ammeter and voltmeter are standard. *(Add to Chap. 3, Water Works Manual)*

Small Air-Cooled Engine

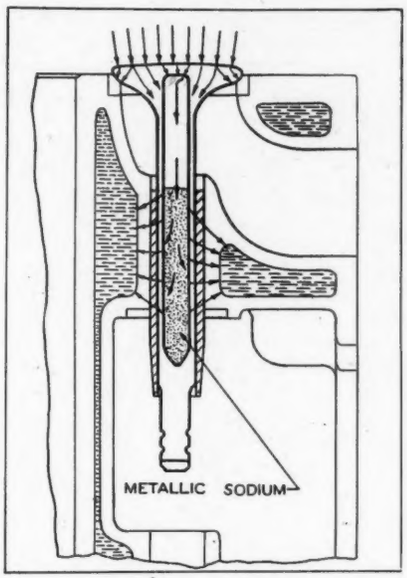
The Clinton No. 700 4-Cycle air-cooled engine is light in weight and easy to operate. It is available, up to 1.5 hp., for immediate delivery for such widely-varied units as: tractors, grain loaders, high-pressure pumps, boats, compressors, spray equipment, belt conveyors, power plants and motor scooters for both business and pleasure. Write the Clinton Machine Co., Clinton, Mich.



The Clinton engine.

Chrysler Industrial Engines

Chrysler industrial engines are designed, engineered and built specifically for application to industrial use and are suited for cranes, shovels, tractors, draglines, pumps, compressors and similar power applications. There are currently available three models: The Ind. 5, 61 brake hp.; the Ind. 7, 63 brake hp.; and the Ind. 12, 93 brake hp. In these engines, the cylinder block is especially designed for rigidity and the cylinder bores are integral with the block. Bearings are overstrength. Exhaust valves are water cooled and oil temperatures are controlled. The sodium-cooled valve is optional equipment, metallic sodium being used to conduct heat from the valve head to the valve stem. Superfinishing of parts is another contribution to long wear. For further data, write Chrysler Motor Corp., Detroit, Mich.



Sodium cooled valve on Chrysler engines.

High Capacity Jet Pump Booster

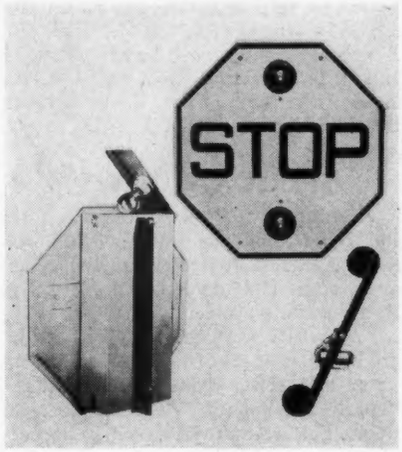
For fire fighting applications where extremely large quantities of water are desired, a larger capacity jet pump booster has been designed. The Model 4-HH delivers over 3 times as much fire fighting water at the tip as the smaller Model 2½; operation is the same except that the 4-HH uses two 2½" return lines from the siamese which is integral with the body.

Designed for use with 750 gallon pumpers or their equivalent, the Model 4-HH, has been found particularly effective by users where hydrant pressure is inadequate, and for dock-side and waterfront fires.

The unit has no moving parts, is readily portable, weighs but 33 lbs., and uses standard 2½" hose connections. Complete details are given in Bulletin 46, which will be sent upon request to Derbyshire Machine & Tool Company, 5218-M Belfield Avenue, Philadelphia 44, Pa.

Activating Road-Side Signs With Winko-Matic

More and better attention for road-side warning and directional signs can be obtained by welding or bolting a winko-matic mechanism to the sign,



The Winko-matic signal.

which is a simple job. This produces the same effect as a blinker or off-and-on flash. Connection to a power source is necessary but either AC or DC current can be used. Full information from Winko-Matic Signal Co., 750 Broadway, Lorain, Ohio. *(Add to Chap. 6, Highway, Street and Airport Manual.)*

ASSOCIATION MEETINGS

NYSSWA.—The annual meeting of the N. Y. State Sewage Works Ass'n will be held at the Henry Hudson Hotel, New York City, Jan. 17. The hotel cannot furnish room facilities for more than a few members and those planning to attend should make suitable arrangements. A. F. Dappert, State Dep't of Health, Albany, N. Y., is Secretary-Treasurer.

N. J. Section, AWWA.—A winter meeting—luncheon and afternoon session—will be held at the Roger Smith Hotel, New Brunswick, N. J., Feb. 20. A summer meeting will be held June 19 and a fall meeting Nov. 6 to 8, the latter at Atlantic City. C. B. Tygert, Box 178, Newark 1, N. J., is Secretary.

PERSONAL NEWS

Thomas H. Milford, Chief Engineer and Director of the Bureau of Sanitation, Alabama State Health Department, since 1946, was killed Nov. 2 in an automobile accident.

James B. Cooke, formerly project engineer in charge of the design of the water and sewer systems for Caracas, Venezuela, is now Resident Manager for Buck, Seifert and Jost, consulting engineers, with headquarters in the Medical Arts Bldg., San Juan, Puerto Rico.

George B. Torrence, formerly Executive vice-president of Link-Belt Co., has been made president, succeeding William C. Carter. Mr. Torrence is a Mechanical Engineer and has been with Link-Belt for 25 years in all.

A. S. Marlow, Sr., president of Marlow Pumps, Ridgewood, N. J., has been elected chairman of the Contractors' Pump Bureau of the Associated General Contractors.

James M. Borrer

James M. Borror has been appointed Galion representative in the Northwest—Washington, Oregon, Idaho, Montana and Wyoming. Mr. Borrer was captain in the Corps of Engineers.

Ned Landis, formerly Lt. Commander, USN, has been made branch manager of the Syracuse, N. Y., office of Allis-Chalmers.

Weaver W. Pangburn, formerly with the National Recreation Association, has joined the F. Ellwood Allen Organization, 101 Park Ave., N. Y., as recreation consultant.

Elton E. Peary, has been appointed Southwest District Manager for the sales of Dresser products to the water industry.

Edgar M. Hastings, Chief Engineer of the RF&P railroad will be the 1947 president of the American Society of Civil Engineers.

Thomas A. DeMarco, formerly with United Aircraft Products Corp., has been made executive assistant to John J. Bergen, chairman of the Board of Gar Wood Industries, Inc. Major DeMarco served with the AAF.

Gilmore Hiett, has been appointed sales and promotion manager for the Gorman-Rupp Co., manufacturers of pumps, Mansfield, Ohio.

Harry C. Ehrick, Chief Engineer of the Huber Mfg. Co., Marion, O., died Aug. 23, at the age of 59.

The Clay Sewer Pipe Association, Inc., has added to its technical staff Joshua M. Sprague. Mr. Sprague is to be District Engineer representing the Clay Sewer Pipe Association in the state of New York and the Atlantic seaboard with his office located at 26 Court Street, Brooklyn, New York. Headquarters of the Clay Sewer Pipe Association are at 1105 Huntington Bank Building, Columbus 15, Ohio.

L. L. Hedgepeth, technical assistant to the vice-president of Pennsylvania Salt Mfg. Co., will, on Dec. 1, become executive secretary of the Virginia Water Control Board. Mr. Hedgepeth has been a leader for many years in waterworks, sewerage and stream pollution engineering.

Herbert Moore has been released from the Sanitary Corps of the Army, after nearly four years of service, and will reopen his office as consulting sanitary engineer, in the Pereles Bldg., 259 East Wells St., Milwaukee, Wis.

Major Russell Vincent, Corps of Engineers, has been assigned as assistant in the Detroit Engineer District, 800 Guardian Bldg., Detroit, Mich.

The following have joined the engineering sales staff of Liquid Conditioning Corp., New York City: John B. Foley, Syracuse, N. Y.; A. W. Schuster, Rochester, N. Y.; P. O. Stribling, jr., Greensboro, N. C.; also appointed as representatives are Brookman-Hazel Associates, Buffalo, N. Y.; Herr-Harris Co., Pittsburgh, Pa.; and Dorner Co., Milwaukee, Wisc.

Ray Long, formerly of the Heil Co., has been made Vice President in charge of sales of the Southern Equipment Sales Co., Greenville and Columbia, S. C. Alec Milne will replace Mr. Long in the Heil organization, with headquarters in Atlanta, which is a new district office for Heil; this is located in the Candler Bldg., and Jack Davies is district manager.

The Lister-Blackstone Co., Inc., Milwaukee 3, Wisc., has moved all production activities to a new and modern plant and will concentrate on the production of straight diesel engines, with few adaptations.

The Atlas Mineral Products Co., Mertztown, Pa., has formed an affiliate organization, the Atlas Mineral Products Co. of Texas, Houston 1, Texas. The new organization includes a manufacturing plant for sulphur products and other materials handled by Atlas; and will also handle sales.

Roots-Connersville Blower Corp. has elected Ralph R. Newquist vice-president in charge of sales.

R. G. LeTourneau, Inc., Peoria, Illinois, has moved its eastern sales office to Washington, D. C. This office, under the management of O. A. (Jack) Williams, is located at 1026 17th St., N. W., 412-413 Defense Building, Washington 6.

Flowrator Is New Name for "Rotameter"

Fischer & Porter Company, Hatboro, Pa., manufacturers of flow rate instruments previously called "Rotameters" has changed the name of its products to "Flowrator."

Highway Equipment Data

Tandem Rollers.—A new 12-page catalog by Galion Iron Works & Mfg. Co., Galion, Ohio, contains detailed construction views and complete specifications. Variable weight design permits meeting requirements of a variety of jobs.

Rock Salt Application.—"Snow and Ice Removal on Highways, Streets and Airports" lives up to its name and tells best methods for application. International Salt Co., Scranton, Pa.

Crawler tractors are described, with the usual excellent Caterpillar pictures, in a 12-page booklet, A Future with a Past, issued by Caterpillar Tractor Co., Peoria, Ill.

Truck cost keeping forms, comprising a complete set necessary to establish operating cost records, are available from Cost Records Dep't., Service Division, FWD Auto Co., Clintonville, Wis.

Clamshell buckets of all-welded construction, ⅜ to 2½ cu. yds. capacity, are described in a new 8-page booklet containing 29 photographs and drawings. C. S. Johnson Co., Champaign, Ill.

Convertible Power Shovel.—A 36-page catalog by Buckeye Traction Ditcher Co., Findlay, Ohio, describes its convertible power shovel features, including vaccum power control, nonclogging crawlers, balanced weight, and fast, positive crowd, hoist, swing and travel. These are shown and described in detail; also the quick convertibility from a power shovel to trench hoe, dragline or crane, clamshell, hook block, magnet, or pile driver. The maker's truck crane and high lift shovels are also pictured and described.

FOR THE ENGINEERS' LIBRARY

These helpful booklets are free to those actively engaged in Engineering or construction. Mail coupon or write direct to addresses given, mentioning PUBLIC WORKS Magazine.

PW 12-46

Readers' Service Dept., PUBLIC WORKS Magazine
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USE THIS COUPON

CONSTRUCTION MATERIALS AND EQUIPMENT

Speed Concreting at Low Temperatures

38. 64-page manual tells how to speed concreting, to secure high early strength and greater workability at temperatures either below or above freezing. 60 photos, charts, graphs and tables. Calcium Chloride Assn., Dept. P.W., LaSalle Bldg., Washington, D. C.

How to Make More Durable Concrete at Low Cost

50. How cement dispersion assures improved concrete with impressive economies in initial construction costs and maintenance costs. Manual from The Master Builders Co., Dept. P.W., 7016 Euclid Ave., Cleveland 3, Ohio.

Solve Your Drainage Problems This Easy, Permanent Way

70. Standard corruguated pipe, perforated pipe and MULTI-PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses. 48-page booklet, No. 12, Armco Drainage and Metal Products, Inc., Dept. PW., Middletown, Ohio.

Methods of Installing Steel Sheet Piling

112. Illustrated descriptions of both standard and interlock corrugated steel sheet piling of minimum weight, maximum strength, ease of handling with methods of installation are contained in a booklet. If you have a job involving piling write Caine Steel Co., Dept. P.W., 1820 N. Central Ave., Chicago 39, Ill.

Reliable Pumps for Every Purpose

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

Weather Can't Affect This Sure-Prime Pump

121. "Sure prime" portable pumps—the full line—describing certain special features for all-weather service, are described in Catalog P-45, to be had by writing The Jaeger Machine Co., 400 Dublin Ave., Columbus 16, O.

You Can See This Pump In Action on Your Own Job

122. To find out how well a Homelite Self Priming Pump handles large volumes, seepage, mud, write today for illustrated Bulletin L-501 containing data of great value to all pump users. Homelite men will demonstrate it anywhere. Write Dept. P.W., Homelite Corp., Port Chester, N. Y.

Winches That Make Heavy Work Easy

200. 1-, 2-, 5-Ton Little Giant Hand Winches take the labor out of any heavy operation. Outstanding design and construction. Latest Bulletin P.W. gives full details. Address: Little Giant Products, Inc., Peoria 3, Ill.

Small Diesel Engines Have Many Municipal Uses

393. Small Diesel engines — down to 3¾ HP. The only stationary Diesel that is air-cooled. For full details on this revolutionary engine for municipal service write R. H. Sheppard Co., 50 Middle St., Hanover, Pa.

Need Street, Sewer or Water Castings?

429. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog P.W. issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave., South Bend 23, Ind.

Free Sample for Curing Concrete, Blocks, Bricks, Etc.

602. Send now for free sample and new methods for curing concrete, blocks, bricks and all masonry. Also protective coatings for metal and wood. Write the Sullivan Co., Dept. PW, Memphis 2, Tenn.

STREETS AND HIGHWAYS

Levels Sidewalks and Curbs Quickly and Easily

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee 10, Wis.

Is Paving Your Bottleneck? Get This Helpful Information

16. Moto-paver is a new type self-contained travelling asphalt plant having a capacity of 100 to 120 tons per hour. A novel spreading and laying device permits quick change to various road widths and crown conditions and thicknesses. Write Hetherington & Berner, Dept. P.W., 729 Kentucky Ave., Indianapolis 7, Ind. for Bulletin MP46 which gives full descriptions and specifications.

Speed Your Work With These Powerful Motor Graders

128. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Here's a Roller for Every Need

141. Three-Wheel and Tandem Rollers, 5 to 8-ton and 10 & 12 ton sizes: also variable weight tandem roller for new highway surfacing and old road conditioning. Ask for new bulletin. Dept. P.W., Huber Mfg. Co., Marion, Ohio.

Looking Into Soil Stabilization?

154. "Soil Stabilization with Tarvia"—An illustrated booklet describing the steps in the stabilization of roadway soil with Tarvia will be mailed on request by Dept. P.W., The Barrett Division, 40 Rector St., New York 6, N. Y.

Here's Your Diesel Tractor!

190. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

Mow Clean and Fast In Tight Corners

510. Send for latest literature about the Cunningham Mower for Fence Rows, Parking Areas, Driveways, Picnic Grounds and many other jobs. 3 ft. cut, variable speed, rugged, easy to handle. James Cunningham, Son & Co., Dept. 16, 13 Canal St., Rochester 8, N. Y.

SEWAGE DISPOSAL

Non-Corrosive, Long Lasting Low Cost of Sewer Pipe

72. Get this new engineering data on clay pipe for sewers. Withstands acid, alkali and gas attacks indefinitely. Cuts maintenance costs to a minimum. Write Dept. P.W., National Clay Pipe Mfrs., 111 W. Washington St., Chicago 2, Ill.

Special Truck Bodies for Every Municipal Need

375. Gar Wood special bodies for sanitary refuse collection are illustrated and described in a new catalog issued by Gar Wood Industries. Dept. P.W., Wayne, Mich.

How Cities Can Do Complete Sewer Cleaning From Street

387. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Three sizes of machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana.

How to Combat Corrosion In Your Gas Holder

412. A 16-page bulletin gives detailed information on the development of corrosion—and how to combat it—in gas holders. A copy will be mailed on request to The Stacey Bros. Gas Construction Company, 5535 Vine St., Cincinnati 16, Ohio.

How to Make Better Sewer Pipe Joints

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

Need a Water-Tight Pipe Joint?

449. Full information on "Hydro-Tite" jointing compound for bell and spigot pipe, together with specifications, instructions; and illustrations both on it and "Fibrex" sanitary joint packing are contained in handsome 48-page booklet. Address: Hydraulic Development Corp., Dept. P.W., 50 Church St., New York.

Does Air Sabotage Your Pipe Lines and Pumps?

357. Automatic Air Release Valves for water, sewage and industrial uses automatically vent air accumulations. Ask for latest illustrated engineering bulletins. Simpex Valve & Meter Co., 6750 Upland St., Philadelphia 42, Pa.

Diesel Generators That Use "No Cost" Sewage Gas

420. Le Roi engine-generator units for operating on "no cost" sewage gas are fully described and illustrated in new bulletins now available. Address Le Roi Co., 1770 S. 68th St., Milwaukee 14, Wis.

Incineration From the Commonsense Standpoint

462. "Disposal of Community Refuse by Incineration" is a handsome 34-page booklet that discusses incineration from a commonsense standpoint. Illustrated by numerous photos of typical installations and includes diagrammatic outlines of various plant designs. Write Morse Boulger Destructor Co., 207-P East 42nd St., New York 17, N. Y.

An Incinerator Necessity

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Dept. P.W., Plainfield National Bank Bldg., Plainfield, N. J.

Ask for This Design Data On Sprinkling Filters

469. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., Dept. P.W., 4241 Ravenswood Ave., Chicago 13, Ill.

Design Details for Sludge Collectors

480. Booklet No. P.W. 1642 on Link-Belt Circuline Collectors contains sanitary engineering data and design details. Catalog No. 1742 on Straightline Collectors, contains layout drawings, installation pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

Packaged Sewage Treatment— Just Right for Small Places

488. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

Look Into This Sewage Treatment Equipment

490. New bulletin P.W. fully describes and illustrates Hardinge sludge collectors for clarifiers, sludge concentration and skimming in both circular and rectangular tanks. Write Dept. P.W., Hardinge Company, Inc., York, Pa.

For All Sludge Dewatering

601. The first filters to be used in large scale operation on primary, elutriated and Guggenheim sludges. Ask for latest engineering Bulletin P.W. General American Process Equipment Div., 420 Lexington Ave., New York 17, N. Y.

WATER WORKS

How to Analyze Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., Dept. P.W., 40 Rector St., New York 6, N. Y.

Do Your Water Mains Need Cleaning?

388. Literature on Flexible method of cleaning water mains any size from 2" to 72", giving full details and list of nearest representatives in all parts of country. Address: Flexible Underground Pipe Cleaning Co., 9059 Venice Blvd., Los Angeles, Calif.

For All Water Tank Maintenance Troubles

389. For all water tank maintenance troubles, whether the need is for repairs, painting, welding, or cleaning, get latest literature of Chicago Tank and Bridge Co., 618 Empire Bldg., Rockford, Ill.

Stops Underwater Rusting Immediately

390. "Preventing Corrosion of Steel Water Storage Tanks" is the subject of an interesting, illustrated bulletin issued by Electro Rust-Proofing Corp., Dayton 10, Ohio. Gives full description of Rustop System of prevention.

Solve Corrosion Problems With This Special Alloy

391. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Company, 25 Broadway, New York.

"Dieselectric" Plants for Low-Cost Light and Power

392. 20-page catalog P.W. describes "Dieselectric" plants 3 to 10 KVA, and diesel engines from 4 to 12 H.P. These are easily transported and will produce reliable, low cost light and power anywhere. Write WITTE ENGINE WORKS, Division of Oil Well Supply Company, Kansas City 3, Mo.

To Measure, Mix, Feed Chlorine or Other Gases

397. Everson SterElators. Bulletins 1063, 1066, 708 and others describe this device for measuring, mixing and feeding chlorine or other gases in solution. Capacities range from ¼ lb. to 2,000 lb. of gas per 24 hours. Address: Everson Manufacturing Co., 214 W. Huron St., Chicago 10, Ill.

Get These Facts About New Vari-I-Feeder

398. There is a new 16-page illustrated booklet on accurate chemical feeding, describing the Var-I-Feeder, which every waterworks, sewage works and swimming pool man will want a copy of. For yours, just address: Chemical Feeders Division, Morse Boulger Destructor Co., 205P East 42nd St., New York 17.

Make Water Extra Safe

399. Safe water may be one of the civic improvements your citizens expect soon. Feeders of all types including Hypochlorinators, Reagent Feeders, Dry Chemical Feeders, Chlorinators and Ammoniators for feeding all of the usual chemicals used in sanitation practice. Ask for latest catalogs. Dept. P.W., Wallace & Tiernan Co., Newark 1, N. J.

Chem-O-Feeders for Automatic Chemical Feeding

400. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. %, 96 Codding St., Providence 1, R. I.

Helpful Data on Hydrants

405. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Dept. P.W., Anniston, Ala.

Don't Miss This Big Hydrant-Valve Catalog

406. Large, handsome, fully illustrated catalog P.W., covering full line of fire hydrants, valves, and kindred items. If you are in the market for them you will want this catalog. Address: Eddy Valve Co., Waterford, N. Y.

Complete Data on Gates, Valves, Hydrants

414. Gate Valves. Double disc bronze mounted, sizes 2" to 72", hand, hydraulic, electric or pneumatic operating, rising or non-rising stem. Bulletin X. Address: Rensselaer Valve Co., Troy, N. Y.

88 Page Book Helps Solve Laboratory Problems

423. pH and Chlorine Control. A discussion of pH control and description of comparators, chlorimeters and similar devices. An 88-page booklet. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

It's Easy to Use This Leak Locator

426. Leak Locators. Again available to waterworks superintendents, the Globe line of leak locators, dipping needles and pipe finders. Several leaflets describing the original Geophone leak locator, Little Wonder pipe phone, and the Magnetite Dipping Needle. Globe Phone Mfg. Corp., Dept. P., Reading, Mass.

Find Your Leaks In a Jiffy

427. For tracing buried pipes and finding hidden leaks get detail of Allen-Howe Leak Detectors, Pipe Locators, Dipping Needle and Pipe Phones. Ask for new circular P.W. 6, Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

What You Should Know About Meter Setting and Testing Equipment

431. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet P.W. you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Cast Iron Pipe and Fittings For Every Need

437. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements Write U. S. Pipe and Foundry Co., Dept. P.W., Burlington, N. J.

Do You Have This Data On Cast Iron Pipe?

438. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc Will be sent promptly by R. D. Wood Co., Dept. P.W., Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Concrete Pipe With Greater Elasticity

442. Lock Joint Reinforced Concrete Sewer Pipe, Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe is described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere. N. J.

Makes Underground Pipe Installations Easy

444. One-man-operated Hydraulic Pipe Pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts and prices, ask for booklet S-117, Greenlee Tool Co., 2042 Columbia Ave., Rockford, Ill.

Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

How About Centrifugal Pumps?

457. Centrifugal Pumps of various designs—single-stage, double-suction, split casing; single-stage single-suction; two-stage opposed impeller; three-stage; high-pressure: fire pumps: close-coupled. A bulletin for each type. Write to Dept. P.W., Peerless Pump Div., Food Machinery Corp., Quincy, Ill.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Have You a Water Conditioning Problem?

481. Installation-tested equipment for complete municipal and industrial systems or individual units. Illustrated and described in latest booklets from Dept. P.W., American Wells Works, Aurora, Ill.

Treating Water With Copper Sulphate

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet P.W. on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

How to Use Alum for Coagulation

502. Alum for coagulation in both sewage and water plants is the subject of literature now available from Dept. P.W., General Chemical Company, 40 Rector St., New York 6, N. Y.

Pittchlor for Water Treatment

503. Get your illustrated booklet P.W. now on *Pittchlor*, a high test calcium hypochlorite, containing minimum 70% of available chlorine. Address, Pittsburgh Plate Glass Co., Columbia Chemical Div., 5th Ave. at Bellefield, Pittsburgh 13, Pa.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

SNOW FIGHTING

For High-Speed Snow Removal

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

End Dangerous Ice Hazards

354. Ice Prevention on Highways, Streets, and Airport Runways with Sterling "Auger Action" Rock Salt. Illustrated bulletin P.W. issued by International Salt Co., Inc., Scranton, Pa.

Fast, Efficient Skid-Proofing

355. Get full facts about Baughman Light-Weight Cinder Spreaders, fast operators for cinders, sand, salt, chips, etc. Free flowing at low temperatures. 9-17 cu. yd. cap. Write Dept. P.W., Baughman Mfg. Co., Inc., Jerseyville, Ill.

HELP WANTED • JOB WANTED HEADQUARTERS

As a service to the industry, we will publish a two-line advertisement in this department, one time, FREE. Extra lines cost only $1 a line. Send your advertisement today. Ads must be received by Dec. 27th for the January issue.

Wanted—Asst. City Engineer. Graduate Civil Engineer preferred. For precise surveys, maintenance and construction. Give age, experience and references. Southern city. Box 100, care of PUBLIC WORKS Magazine.

Help Wanted—Sanitary Engineer—Salary open, by month or percentage. Jenson & Johnson, Elkhorn, Wisc.

A large eastern university has two vacancies: 1) A sanitary engineer with experience in water and sewage work and capable of taking over a sanitary chemistry laboratory, with special reference to public health practice; salary $3600 to $5500. 2) A man qualified for survey health department practices and effectiveness; must have 5 years of experience. Salary $5100. Write JH. care of WAH, this magazine.

One of the Standard Oil group needs an engineer skilled in industrial waste. Write JH, care of this magazine.

Florida State Dep't of Health is seeking three assistant sanitary engineers. Write D. B. Lee, State Sanitary Engineer, Jacksonville, Fla.

Large equipment company needs a sanitary engineer, engineering degree essential. Write ST, care of Col. Hardenbergh, this magazine.

Minnesota State Dep't of Health, H. M. Bosch, State Sanitary Engineer, wants trainees in public health. Must have engineering degree. After satisfactory work, department will send trainee to graduate school.

Engineer experienced in corrosion control of water systems and appurtenances. Involves travel in U. S. P-5 rating (approximately $5500-6000). Write FPHA, care of this magazine.

U. S. Navy wants 225 men for appointment as Lt. (j.g.), CEC. Age 22-30; college degree in engineering required. Office of Naval Procurement, 1601 Eye St., N.W., Washington, D. C.

Two men about 30 years old needed for road material, educational and promotional work—one near Minneapolis, one near Denver. Highway education and training essential. Salary around $3600. BEG care of this magazine.

A sanitary engineer with experience in mosquito control, water supply and waste disposal is needed by an American oil company for service in Arabia. Salary to $7200. Address TO, care WAH, this magazine.

2 or 3 men wanted in Venezuela for schistosomiasis research and control. $595 per month. Address AW, care of WAH, this magazine.

Advertising Index

"THE FLEET'S IN"

Henry Nelson, commissioner of public works; Bernt Molbeck, council president; and Frank Marino, chairman of the streets committee, with new Internationals recently delivered to the City of Racine, Wisconsin.

THAT'S THE WAY a Racine, Wisconsin, newspaper started its story about the new International Trucks recently put into municipal service by the city.

Yes, the fleet was in—a fleet of ten Internationals equipped with ash and garbage collection bodies. And fourteen more Internationals are on order.

Racine's choice of Internationals was based on the same solid reason that has earned these rugged trucks their outstanding reputation in municipal service.

And that solid reason is dependable performance—performance so dependable that for the last 15 years more heavy-duty International Trucks have served American commerce and industry than any other make.

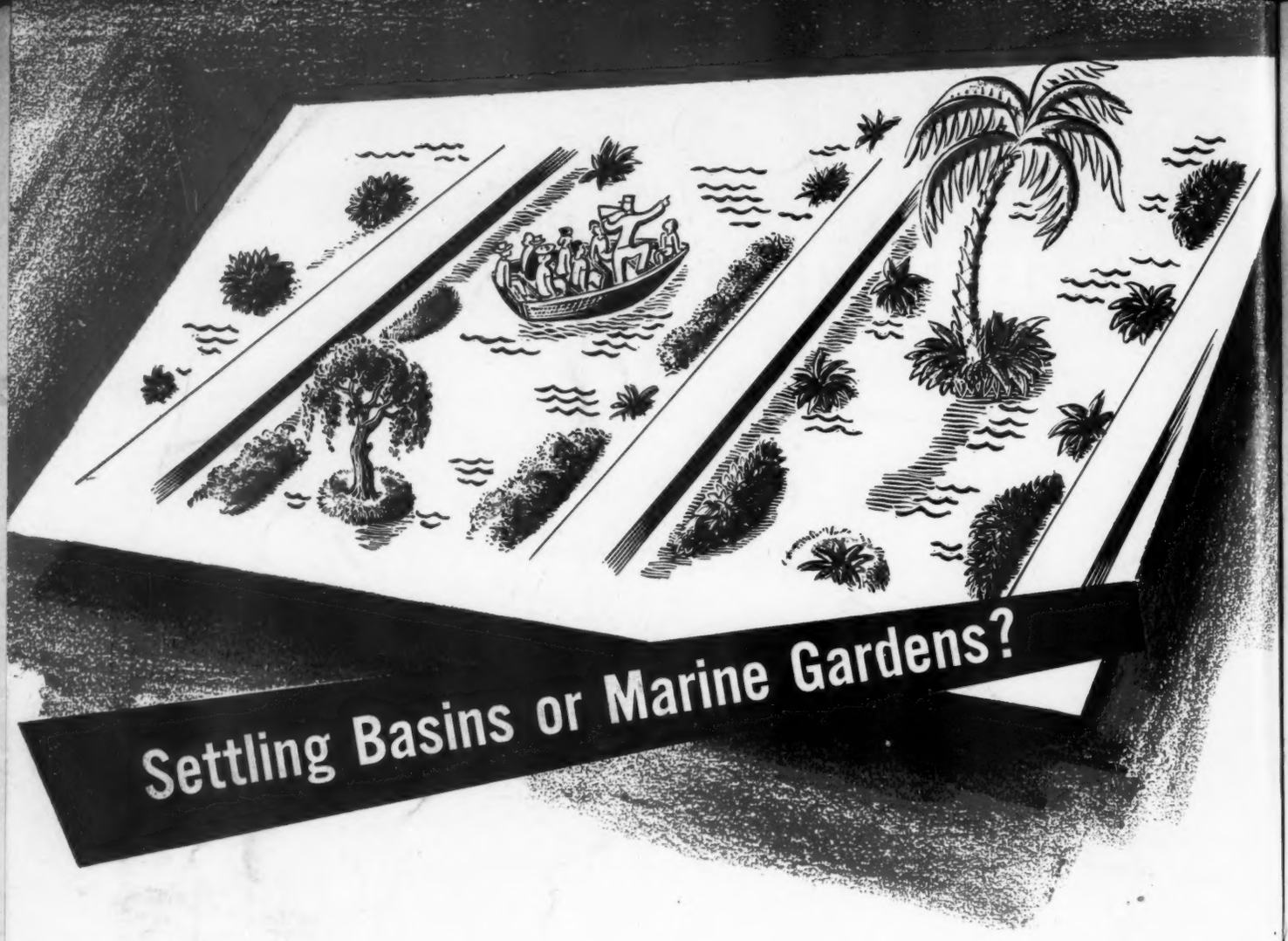
Another factor that highly recommends Internationals to municipalities is this:

The International Line is a *complete* line. It includes a truck of the right type and power for every municipal job. That means the right recommendation from your International Dealer or Branch.

Motor Truck Division
INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue, Chicago 1, Illinois

Tune in James Melton on "Harvest of Stars" Every Sunday! NBC Network
See newspaper for time and station

INTERNATIONAL TRUCKS

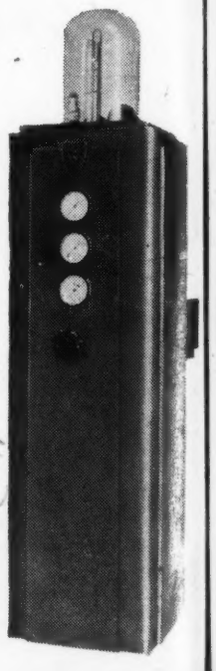


Settling Basins or Marine Gardens?

That was a fair question at a 10 M.G.D. industrial water plant in 1943 when algal growths in settling basins and storage reservoirs were getting the upper hand. In 1944, however, the prechlorination dosage was increased to between 2.5 and 3.0 ppm. The free chlorine residual thus achieved has held down the algae and in addition has reduced slime problems throughout the mill.

But that's not all — the free chlorine residuals maintained by prechlorination carry through an open storage reservoir to give the added safety factor of a 0.5 ppm residual on the outlet.

This is just another instance of multi-purpose prechlorination—one of the many cases where it is helping to solve problems of algae control, coagulation, increased filter runs or improved water quality. Why not call your W & T Representative today and let him show you how prechlorination can be put to work in your plant.



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